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Engine Structures Modeling Software System: Computer Code User's Manual

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1.0 ESMOSS EXECUTIVE

1.1 Introduction

ESMOSS is a specialized software system for the construction of geometric descriptive and discrete analytical models of engine parts, components and substructures which can be transferred to finite element analysis programs such as NASTRAN. The software achitecture of ESMOSS is designed in modular form with a central executive module through which the user controls and directs the development of the analytical model. Modules consist of a geometric shape generator, a library of discretization procedures, interfacing modules to join both geometric and discrete models, a deck generator to produce input for NASTRAN and a "recipe" processor which generates geometric models from parametric definitions.

1.2 Program Execution

ESMOSS can be executed both in interactive and batch modes. Interactive mode is considered to be the default mode and that mode will be assumed in the discussions in this document unless stated otherwise.

The first question asked by ESMOSS is.

BATCH OR INTERACTIVE?

to which the user answers "I" or "B". If the program is being run as a batch program, the user input is read from the batch input stream which must match the user interactions which would have resulted from an interactive run. If interactive mode is selected, input is obtained from the user's terminal.

Next, the user is asked to input his terminal type and the plotting device from lists of supported terminals and plotting devices. Finally, the user is asked if a new menu file is to be built or a special menu file is to be used. In general, the answer to these question will be "N". More information about building menu files can be found in Section 2.1.

1.3 Menu Processing

Once the user has answered the initial questions, the program enters command mode and the Master Menu will appear.

MASTER MENU

1 EXECUTE COMMAND FILE
2 UTILITY COMMANDS
3 GEOMETRY MODEL CONSTRUCTION
4 DISCRETE MODEL CONSTRUCTION
5 RECIPE ENGINE PARTS
6 GENERATE ANALYSIS INPUT
7 FILE HANDLER
8 DONE

While in command mode the user will be asked to input menu commands by the prompt:

ENTER MENU COMMAND>>

Each command entered will either call another menu or cause execution of an ESMOSS module. Once the user has entered a command that causes execution of one of the ESMOSS modules, that module may ask for input needed for execution.

ESMOSS allows maximum flexibility in the format of the entered menu commands. Each menu item has an associated number which can be used to select that item. Additionally, the command can be typed in either its entirety or an abbreviated form which makes it unique from the other items. For example, in the menu above the item EXECUTE COMMAND FILE could be selected by any of the following:

1
EXECUTE COMMAND FILE
E C F
EX
E

Multiple menu commands can be stacked on a single line separated by commas. This feature is useful if the user wants to proceed to a menu level other than his current level and knows the menu items that need to be selected to get him there. Additionally, ESMOSS remembers how it got to the current level and allows the user to back up n levels by typing "-n". Some menus have a mandatory END item that forces the user to select that item before backing out of that menu. This is to assure that buffers and files are terminated properly from one model to the next.

1.4 Utility Menu

In addition to the items in the current menu, the user may select an item from the utility menu any time that ESMOSS is in command mode. The utility menu contains the following items:

1 UTILITY COMMANDS - causes the Utility Menu to become the current menu.

2 MENU REDISPLAY - causes the current menu to be redisplayed.

3 HELP n - displays further information about the nth item in the current menu. If n is not specified, information will be displayed about all items in the current menu.

4 CHANGE SESSION PARAMETERS - allows modification of session parameters. See Section 1.5 for a description of session parameters.

5 PLOT MODEL - plots the current model on the plotting device that was specified by the user during initialization.

6 CHANGE PLOT PARAMETERS - changes the current plot parameters. See Section 1.9 for a description of the plot parameters.

7 DONE - terminates the ESMOSS session.

1.5 Session Parameters

ESMOSS contains several processing options which are selectable from the Utility Menu. They allow the following:

a) Command file execution - see Section 1.8.

b) Echo File usage - see Section 1.8.

c) Suppression of menus and user prompts - used to suppress screen output when executing a Command File.

1.6 File Management

Once the user has selected a menu item that causes a module to be executed, all files required by that module are accessed. The user is prompted to input the name of each necessary file. If a file of the required type is already accessed it is considered a default file and the user can specify that that file be used. The requested files are accessed and added to the Logical Unit Table and are marked as the default files for those file types for subsequent module executions.

1.7 File Manipulation

In addition to the automatic accessing of files provided by the File Manager, the user has the option of manipulating files himself via the File Maniputator. The File Manipulator, which is entered through the Master Menu command FILE HANDLER, has the capability to access and deaccess files as well as list the contents of the Logical Unit Table.

The File Manipulator also maintains a record of ESMOSS created files on the ESMOSS File Directory. The File Manipulator allows the user to add files to or delete files from this directory as well as list the directory contents. The directory contains the file name as well as file type, creation date and creator for each file.

1.8 Input Processing

As mentioned previously, ESMOSS input can come from several sources. In addition to terminal input for interactive mode, ESMOSS allows the user to provide his input from a command file. A command file is an ASCII file which contains one user input response per line. The command file must contain a response to every ESMOSS prompt in the processing sequence. If the user wishes a particular response to come from the terminal rather than from the command file, the line on the command file that contains that response must contain a "/*SWITCH".

Command files are invoked by the command EXECUTE COMMAND FILE which is selectable from both the Master Menu and the Change Session Parameters utility menu. Command file execution is terminated by the character sequence "/*OFF" on the file.

Command files can be created off-line using a standard text editor or created as an echo file during an interactive session. The echo file is turned on via the command ECHO FILE ON and turned off by the command ECHO FILE OFF. These commands are items in the Change Session Parameters utility menu. Once the echo file is created it can be used to reproduce the ESMOSS session by using the created echo file as a command file. Since the echo file is an ASCII file it can be edited to modify the session.

1.9 Output Processing

The ESMOSS Output Processor processes four types of output.

1. Menu Display
2. User Prompts
3. Error Messages
4. Model Plots

Menus and user prompts will be suppressed for batch mode and can be suppressed for interactive mode if desired (see Section 1.5).

Two commands in the Utility Menu are used to control the plotting of geometric and discrete models.

PLOT MODEL - plots the current model using the current plot parameters.

CHANGE PLOT PARAMETERS - allows the user to set the parameters used for creating the model plot.

The Plot Parameters Menu allows user control over the following parameters:

DEFAULT VALUES - resets all parameters to their original values.

DISPLAY MODE - incremental mode allows plots to be generated entity by entity as the models are being built. Complete mode waits to plot until the model is complete or until a PLOT MODEL command is given.

INTENSITY - sets the intensity for devices with that option.

TITLE - assigns a one to sixty character title to the plot.

ROTATE - rotates the plot view about the x, y and z axes.

COLOR - sets the color for devices with that option.

WINDOW - sets the window maximum and minimum values as percentages along each axis. ESMOSS automatically scales the plot to fit the screen if AUTO SCALE is specified.

LABEL - allows the labeling of all points, curves, surfaces, regions, nodes and elements or a subset of any of them.

VISIBILITY - allows the selective plotting of entities or subsets of entities.

2.0 CREATING NEW MODULES

2.1 Menu Creation

The ESMOSS Menu is created from an ASCII input file which defines the menu structure and parameters. When adding new menus to ESMOSS, each item either points to another menu which further subdivides the function or it specifies the execution of a module. Each menu on the file has the following format.

```
Menu Number, Menu Count
Menu Title
  Menu Command 1
    Action Code, Action Entry, Help Count, File Count
    Help Line 1
          .
          .
    Help line n
    File Type 1, File Mode 1
    Prompt Message 1
          .
          .
    File Type m, File Mode m
    Prompt Message m
 Menu Command 2
          .
          .
 Menu Command j
          .
          .
```

Where:

j = Menu Count
n = Help Count
m = File Count

The parameters used in the above definition are defined as follows.

Menu Number - the identification address for the menu (1-100).

Menu Count - number of items in the menu (1-12).

Menu Title - title that is displayed when the menu is selected (1-72 characters).

Menu Command - command that is displayed for the menu item (3 words of 1-12 characters)

Action Code - action caused by selection of the item.

1 = Select another menu
5 = Execute module
7 = Execute module and end menu

Action Entry - data needed for the particular Action Code.

For Action Code = 1
1.N Select menu with Menu Number N
For Action Code = 5 or 7
N.M Execute module number N, submodule M

Help Count - number of lines of Help information.

File Count - number of files required by the module.

Help Line - ASCII Help message line (1-72 characters).

File Type - type of file required.

1 = Command input file
2 = User echo file
3 = Geometric definition file
4 = Discrete definition file
5 = Menu Directory input file
6 = Menu Directory output file
7 = Active Menu Directory
8 = Command output file
9 = File Directory file
10 = Nastran data file
11 = Nastran input file
12 = Recipe input file
13 = Finalization data file

File Mode - I/O mode of the required file.

1 = File is opened for input
2 = File is opened for output
3 = File is opened for input and output

Prompt Message - prompt to user which requests the file name (1-72 characters).

A listing of the current ESMOSS menu is given in Appendix A.

2.2 Module Creation

ESMOSS modules are called from subroutine EXMOD. Each module has an associated module number. The module numbers for the current ESMOSS modules are

1 = Geometric Shape Generator
2 = Discretization Procedures Library
3 = Plot Parameters Library
4 = Recipe Processor
5 = Analysis Input Generator

Any newly developed modules would be assigned a unique module number. The data passed to the module via the calling sequence is.

Sub Module Number - further functional definition assigned by the module author.

File Code List - list of file codes for files defined in the file requirements section of the menu.

3.0 GEOMETRIC SHAPE GENERATOR

3.1 Introduction

ESMOSS allows the user to construct geometric entities consisting of points, curves, surfaces, and regions. All entities are represented internally as rational B-splines. In constructing geometry, the user must name all entities following the ESMOSS convention. Point names consist of "P" plus a numeric name from 1 to 999 (e.g. P1, P243, P14). Curve names consist of "C" plus a numeric name from 1 to 999 (e.g. C2, C69, C861). Surface names consist of "S" plus a numeric name from 1 to 999 (e.g. S1, S49, S210). Region names consist of "R" plus a numeric name from 1 to 200 (e.g. R1, R30, R141).

After the GEOMETRY MODEL CONSTRUCTION option has been selected from the Master Menu, the options for construction will appear. The user must first define a geometry file to be used by ESMOSS (option 1) and the limits of the window for construction. He is then is free to proceed to construct points, curves, surfaces and regions or to combine two models together using the geometric interfacing option. The only permissible method of leaving this menu is by selecting the END option. This selection will deactivate the geometry file and return to the Master Menu.

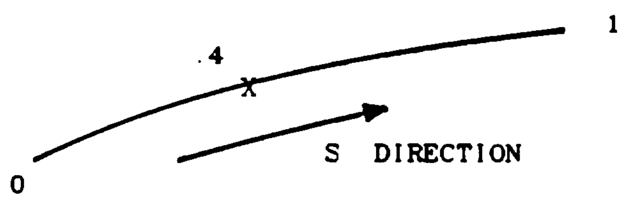
Once an entity construction menu is selected (e.g. Point Menu), a new menu will appear with the options available to construct that type of geometry. The user is free to choose any of the available methods of construction or to delete an entity. If for any reason the construction cannot be accomplished (necessary entities are not defined, parameters are out of range or proper input is not entered), the command will not be executed and the prompt will return to the present menu. If a particular type of entity menu is displayed and the user wishes to change to a differnt type of geometry construction, he enters a " -1" to return to the Geometry Construction Menu and then requests the desired menu. For example, if the Point Menu is current, and the user wishes to switch to a Curve Menu, he enters a "-1", and when the Geometry Model Construction menu appears, enters a "3" to select the Curve Menu.

3.2 Point Construction

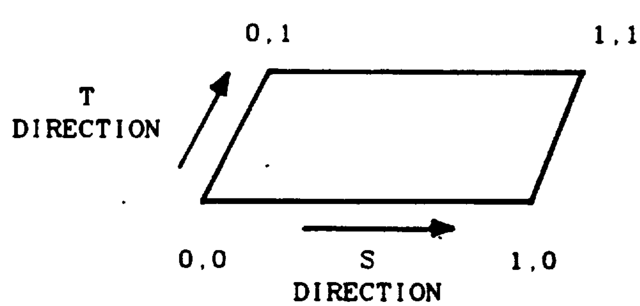
There are five methods available in ESMOSS to create points as well as the option to delete a point that has been previously defined. The first method of construction is the basic explicit definition of a point. The user must input the point coordinates, which can either be rectangular (X.Y.Z), cylindrical (θ,R,Z), or spherical (θ,ρ,ϕ). Regardless of the type of input, the point values will be converted internally to rectangular form for processing and output. All angle values are entered in degrees.

The second method is to use a file containing the (X,Y,Z) coordinates of points. The file should be a sequential file containing the point coordinates in real variable format. The user will be asked where to start reading in the file (i.e. how many points to skip), how many points to define, and the point names. For example, if the user wanted coordinates 6,7, and 8 in the file defined as P21, P24, and P30, he would enter "5" for the prompt "ENTER NUMBER OF POINTS TO SKIP IN THE POINT FILE >>", and for the prompt "ENTER NUMBER OF POINTS >>" he would type in a "3", because there will be three points defined. ESMOSS will then ask for the three point names to correspond to the three coordinate values. Each time a set of points is defined, the file marker will be reset at the top of file position.

The third method of defining points is to use the parametric definition of a curve. A B-spline curve in ESMOSS has an "S" direction associated with it. The S parameter that defines the curve ranges from 0 to 1, with 0 being the start of the curve and 1 being the end point of the curve. All other points on the curve can be defined by inputting a number between 0 and 1 for the S parameter to define the appropriate point on the curve. For example, an S parameter definition of .4 will result in a point being defined 4/10 of the way along the curve as it is traversed from the zero value or starting point.



The fourth way to define a point is the parametric surface. A B-spline surface in ESMOSS has an "S" and a "T" direction. Each parameter ranges from 0 to 1, therefore, an S and T value of 0,0 would be one corner of the surface, and a value of 1,1 would be the opposite corner of the surface. Any other values between 0 and 1 will result in interior points corresponding to that position on the surface. Negative S and T values or values greater than 1 will be ignored. For example, an S and T value of .5 will result in a point being defined at the center of the surface.



The final way of defining a point is by the intersection of two curves. The required input is two previously defined curves that intersect each other in a unique place. If a point near the intersection point is already defined, it can be used as a guide point to reduce CPU time in locating the intersection, however, this is not required.

An additional option in the point menu is the capability to delete a point that has been already defined and is no longer needed. The only required input is the name of the point.

Point Construction - Basic Definition

```
 ENTER MENU COMMAND >>
1
BASIC DEFINITION (X,Y,Z)
ENTER POINT NAME >>
P1
MAKE INVISIBLE (Y/N)? >>

ENTER COORDINATE TYPE >>
 ('L'=LIST CHOICES)
L
COORDINATE TYPES:

 'REC' OR RETURN
      =RECTANGULAR
 'CYL'=CYLINDRICAL
 'SPH'=SPHERICAL

ENTER COORDINATE TYPE >>
 ('L'=LIST CHOICES)

ENTER POINT (X,Y,Z) >>
0 0 0
 ENTER MENU COMMAND >>
1
BASIC DEFINITION (X,Y,Z)
ENTER POINT NAME >>
P2
MAKE INVISIBLE (Y/N)? >>

ENTER COORDINATE TYPE >>
 ('L'=LIST CHOICES)
CYL
ENTER POINT (R,T,Z) >>
1 45 0
 ENTER MENU COMMAND >>
1
BASIC DEFINITION (X,Y,Z)
ENTER POINT NAME >>
P3
MAKE INVISIBLE (Y/N)? >>

ENTER COORDINATE TYPE >>
 ('L'=LIST CHOICES)
SPH
ENTER POINT (R,T,P) >>
1 45 45
 ENTER MENU COMMAND >>
```


```
POINT MENU

 1  BASIC DEFINITION (X,Y,Z)        3  PARAMETRIC CURVE        5  TWO CURVE INTERSECTION
 2  POINT FILE                      4  PARAMETRIC SURFACE      6  DELETE
```

Point Construction - Point File

```
 ENTER MENU COMMAND >>
2
POINT FILE
-- POINT FILE REQUIRED --
ENTER FILE NAME >>
AEECJMT.PTFIL.DATA
ENTER NUMBER OF POINTS TO
  SKIP IN THE POINT FILE >>
0
ENTER NUMBER OF POINTS >>
6
ENTER POINT NAME >>
PS0
MAKE INVISIBLE (Y/N)? >>

 ENTER POINT NAME >>
PS1
MAKE INVISIBLE (Y/N)? >>

 ENTER POINT NAME >>
PS2
MAKE INVISIBLE (Y/N)? >>

 ENTER POINT NAME >>
PS3
MAKE INVISIBLE (Y/N)? >>

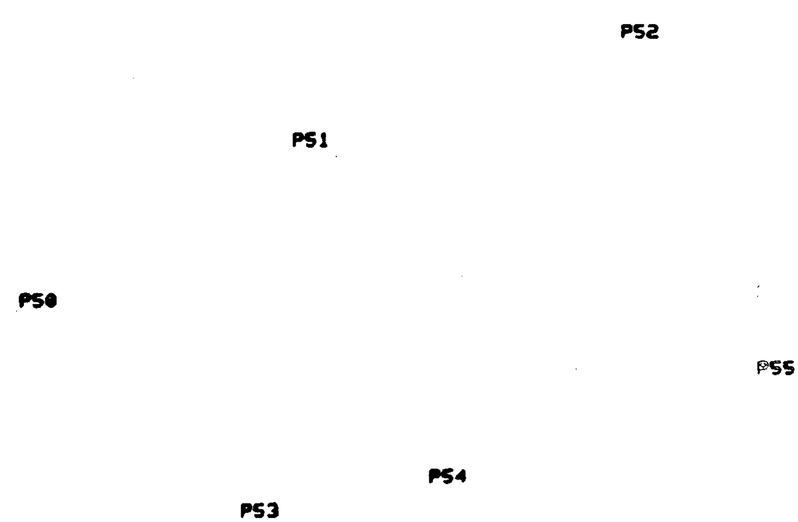
 ENTER POINT NAME >>
PS4
MAKE INVISIBLE (Y/N)? >>

 ENTER POINT NAME >>
PS5
MAKE INVISIBLE (Y/N)? >>

 ENTER MENU COMMAND >>
```

PTFIL.DATA

```
0,0,0
.5,1,1
1.5,2,2
2,0,0
2,1,0
3,2,1
```

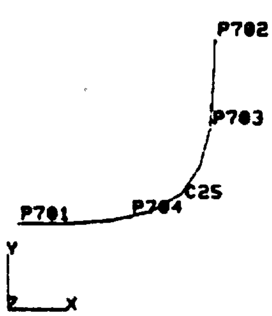



```
POINT MENU

1  BASIC DEFINITION (X,Y,Z)      3  PARAMETRIC CURVE       5  TWO CURVE INTERSECTION
2  POINT FILE                    4  PARAMETRIC SURFACE     6  DELETE
```

Point Construction - Parametric Curve

```
 ENTER MENU COMMAND >>
3
PARAMETRIC CURVE
ENTER POINT NAME >>
P701
MAKE INVISIBLE (Y/N)? >>
ENTER REFERENCE CURVE >>
C25
ENTER S PARAMETER >>
0
 ENTER MENU COMMAND >>
3
PARAMETRIC CURVE
ENTER POINT NAME >>
P702
MAKE INVISIBLE (Y/N)? >>
ENTER REFERENCE CURVE >>
C25
ENTER S PARAMETER >>
1
 ENTER MENU COMMAND >>
3
PARAMETRIC CURVE
ENTER POINT NAME >>
P703
MAKE INVISIBLE (Y/N)? >>
ENTER REFERENCE CURVE >>
C25
ENTER S PARAMETER >>
.75
 ENTER MENU COMMAND >>
3
PARAMETRIC CURVE
ENTER POINT NAME >>
P704
MAKE INVISIBLE (Y/N)? >>
ENTER REFERENCE CURVE >>
C25
ENTER S PARAMETER >>
.3
 ENTER MENU COMMAND >>
```

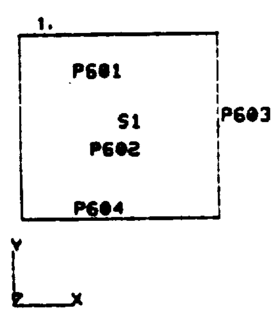


POINT MENU

1 BASIC DEFINITION (X,Y,Z)	3 PARAMETRIC CURVE	5 TWO CURVE INTERSECTION
2 POINT FILE	4 PARAMETRIC SURFACE	6 DELETE

Point Construction - Parametric Surface

```
 ENTER MENU COMMAND >>
4
PARAMETRIC SURFACE
ENTER POINT NAME >>
P601
MAKE INVISIBLE (Y/N)? >>
ENTER REFERENCE SURFACE >>
S1
ENTER S,T PARAMETERS >>
.25 .75
 ENTER MENU COMMAND >>
4
PARAMETRIC SURFACE
ENTER POINT NAME >>
P602
MAKE INVISIBLE (Y/N)? >>
ENTER REFERENCE SURFACE >>
S1
ENTER S,T PARAMETERS >>
.33 .33
 ENTER MENU COMMAND >>
4
PARAMETRIC SURFACE
ENTER POINT NAME >>
P603
MAKE INVISIBLE (Y/N)? >>
ENTER REFERENCE SURFACE >>
S1
ENTER S,T PARAMETERS >>
1 .5
 ENTER MENU COMMAND >>
4
PARAMETRIC SURFACE
ENTER POINT NAME >>
P604
MAKE INVISIBLE (Y/N)? >>
ENTER REFERENCE SURFACE >>
S1
ENTER S,T PARAMETERS >>
.25 0
 ENTER MENU COMMAND >>
```



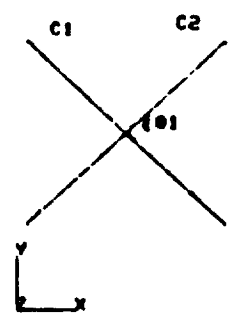
POINT MENU

1 BASIC DEFINITION (X,Y,Z)
2 POINT FILE
3 PARAMETRIC CURVE
4 PARAMETRIC SURFACE
5 TWO CURVE INTERSECTION
6 DELETE

Point Construction - Two Curve Intersection

```
 ENTER MENU COMMAND >>
5
TWO CURVE INTERSECTION
ENTER POINT NAME >>
P101
MAKE INVISIBLE (Y/N)? >>

ENTER THE TWO CURVES >>
C1 C2
USE GUIDE POINT (Y/N)? >>
N
 ENTER MENU COMMAND >>
```



POINT MENU

1 BASIC DEFINITION (X,Y,Z)	3 PARAMETRIC CURVE	5 TWO CURVE INTERSECTION
2 POINT FILE	4 PARAMETRIC SURFACE	6 DELETE

3.3 Curve Construction

There are eight methods available in ESMOSS to create curves plus the option to delete a curve that has been previously defined. The first method is the definition of a line. This is the simplest form of a curve and consists of two endpoints connected using a linear fit.

The second option is the definition of a circle. The user can define a circle in two ways - by specifying a center point and two points on the circumference or by specifying three points on the circumference. If the center point option is selected, the three points used to define the circle must not be collinear. The user is also prompted with the question "AILOW UNEQUAL RADII <Y/N>?". If the user answers "NO" to this question, a check is performed to ensure that circumference points are equidistant from the center of the circle to within a tolerance of .25% of the radius. If the user allows unequal radii, then the first circumference point selected will be used to resolve any radius discrepencies. The circle is fitted using a 16 point interpolation.

The circular arc can be generated in the same manner as the circle, except the only permissible way to define a semi-circle is by using the three points on the circumference option. If an obtuse arc is to be defined (angle greater than 90 degrees), the circumference option must also be used. Defining an arc using a center point and two circumference points will always default to an acute angled arc.

The fourth method of curve generation is using the intersection of two surfaces. The surfaces that intersect each other must have been previously defined. Also required is the number of points to be produced on the curve of intersection and the number of B-splines to be produced (usually one). If the curve of intersection is not linear, the greater the number of points used to fit, the more closely the fit will be to the intersection of the two surfaces.

The point file method of curve generation works similarly to the method for defining points. A sequential file of point data is read and various points are selected by the user to construct curves. The user is asked for the number of points in the curves and the number of B-splines to fit the curve (this number is usually one). These points are then read from the file and used to fit a curve. Each time a curve is defined, the file pointer sits at the top of file position, therefore, to select points from within the file, the user must designate the number of points to skip over in the file to reach the data that is desired. For example, if point coordinates 3,4,5 and 6 in the file are required to fit a curve, then for the prompt "ENTER NUMBER OF POINTS TO SKIP IN THE POINT FILE >>" he would enter "2", because he wishes to start at the third line of the file. For the prompt "ENTER THE NUMBER OF POINTS TO EVALUATE ALONG THE CURVE >>", he would enter "4", and for the prompt "ENTER THE NUMBER OF B-SPLINES REQUIRED TO FIT THE CURVE >>" he would enter "1". ESMOSS then takes points 3,4,5 and 6 from the data file and fits a curve using those four control points. All point data files should be constructed with one point coordinate per line (i.e. one set of X,Y,Z values per line).

Another curve generation method is to fit a sequence of points. The user must input the number of points in the curve and the number of B-splines to fit the curve (usually one). The point names are then input and a cubic fit is performed on the entered control points to construct a curve.

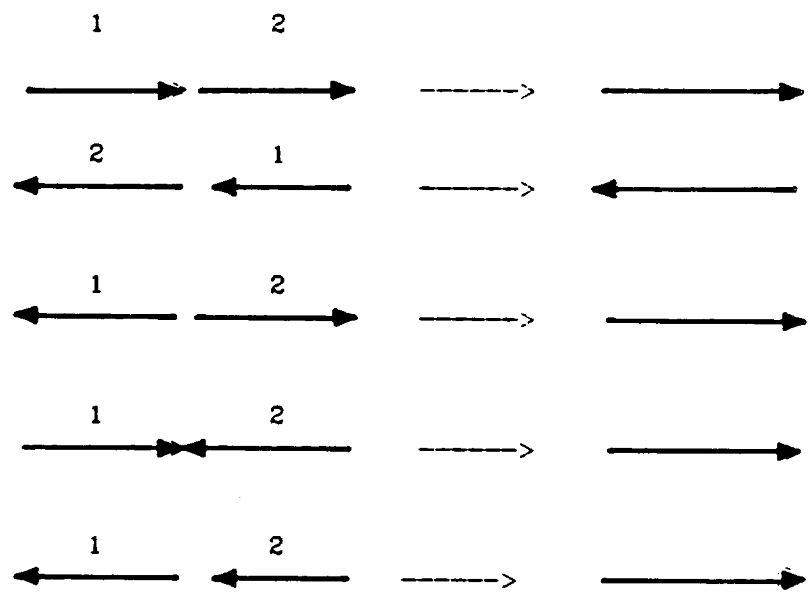
The seventh method is the merging of two curves. The curves must be open and the end point of the first curve must meet the start of the second curve to within a tolerance of 1% of the length of the longest curve. The curves may be defined in any direction or in any order, but one endpoint must be tangent to another endpoint. Once the merge is completed, the ending point of the first curve will be at the same position as the starting point of the second curve. Below are the four possible cases for curve merger.

1. Both curves OK

2. Reverse 1 st curve

3. Reverse 2 nd curve

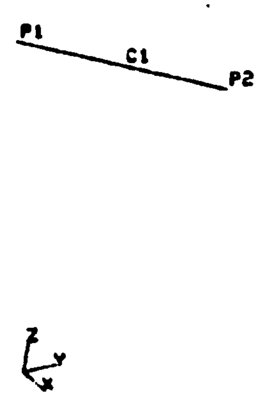
4. Reverse both curves



The final option is the definition of a parabola. A parabola can be defined by a vertex point and two endpoints or by two endpoints and two tangents to those endpoints. If the tangent option is used, two <X,Y,Z> directional vectors are required that converge to a vertex point.

Curve Construction - Line

```
 ENTER MENU COMMAND >>
1
LINE
ENTER CURVE NAME >>
C1
MAKE INVISIBLE (Y/N)? >>
ENTER THE 2 LINE END POINTS >>
P1 P2
 ENTER MENU COMMAND >>
```



CURVE MENU

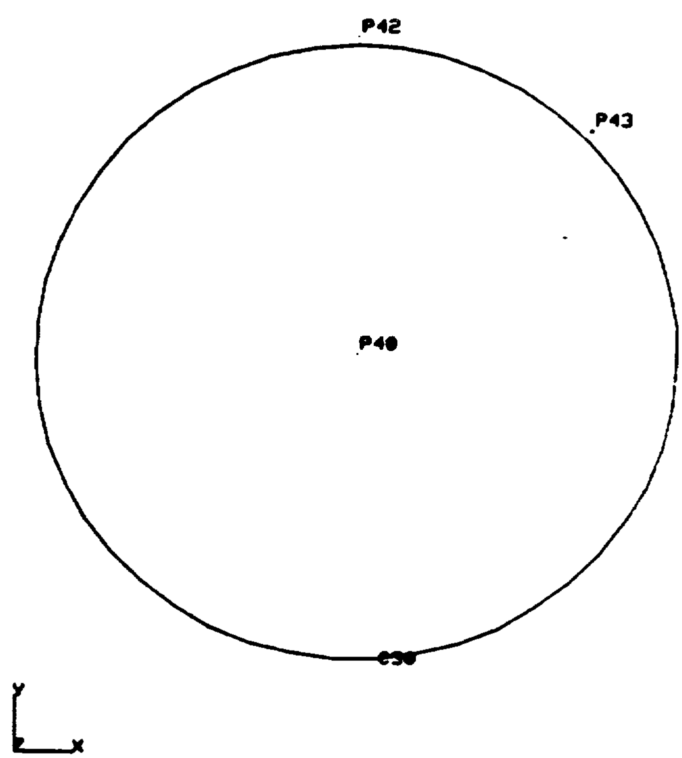
```
1  LINE                      4  TWO SURFACE INTERSECTION      7  MERGE TWO CURVES
2  CIRCLE                    5  POINT FILE                    8  PARABOLIC ARC
3  CIRCULAR ARC              6  FIT POINT SEQUENCE            9  DELETE
```

Curve Construction - Circle

```
 ENTER MENU COMMAND >>
2
CIRCLE
ENTER CURVE NAME >>
C30
MAKE INVISIBLE (Y/N)? >>

ENTER DEFINITION TYPE >>
  ("CEN"=CENTER)
  ("CIR"=CIRCUMFERENCE)
CEN
ENTER CENTER POINT >>
P40
ENTER 2 POINTS ON CIRCLE >>
P42 P43
ALLOW UNEQUAL RADII (Y/N)? >>
Y
 ENTER MENU COMMAND >>
2
CIRCLE
ENTER CURVE NAME >>
C31
MAKE INVISIBLE (Y/N)? >>

ENTER DEFINITION TYPE >>
  ("CEN"=CENTER)
  ("CIR"=CIRCUMFERENCE)
CEN
ENTER CENTER POINT >>
P40
ENTER 2 POINTS ON CIRCLE >>
P42 P43
ALLOW UNEQUAL RADII (Y/N)? >>
N
% RADII ARE NOT EQUAL
% COMMAND NOT EXECUTED
ENTER MENU COMMAND >>
```

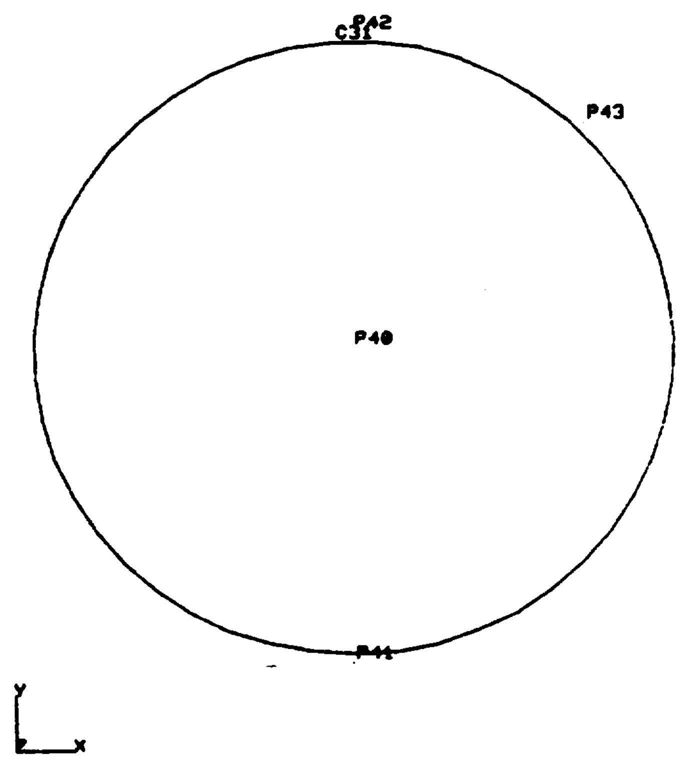


CURVE MENU

```
1  LINE              4  TWO SURFACE INTERSECTION     7  MERGE TWO CURVES
2  CIRCLE            5  POINT FILE                   8  PARABOLIC ARC
3  CIRCULAR ARC      6  FIT POINT SEQUENCE           9  DELETE
```

Curve Construction - Circle

```
 ENTER MENU COMMAND >>
2
CIRCLE
ENTER CURVE NAME >>
C31
MAKE INVISIBLE (Y/N)? >>
ENTER DEFINITION TYPE >>
  ('CEN'=CENTER)
  ('CIR'=CIRCUMFERENCE)
CIR
ENTER 3 POINTS ON CIRCLE >>
P41 P42 P43
ALLOW UNEQUAL RADII (Y/N)? >>
Y
 ENTER MENU COMMAND >>
```



CURVE MENU

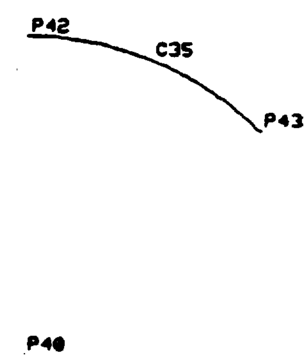
1 LINE	4 TWO SURFACE INTERSECTION	7 MERGE TWO CURVES
2 CIRCLE	5 POINT FILE	8 PARABOLIC ARC
3 CIRCULAR ARC	6 FIT POINT SEQUENCE	9 DELETE

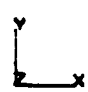
Curve Construction - Circular Arc

```
 ENTER MENU COMMAND >>
?
CIRCULAR ARC
ENTER CURVE NAME >>
C35
MAKE INVISIBLE (Y/N)? >>

ENTER DEFINITION TYPE >>
  ('CEN'=CENTER)
  ('CIR'=CIRCUMFERENCE)
CEN
ENTER CENTER POINT >>
P40
ENTER THE 2 ARC END POINTS >>
P42 P43
ALLOW UNEQUAL RADII (Y/N)? >>
Y

 ENTER MENU COMMAND >>
```





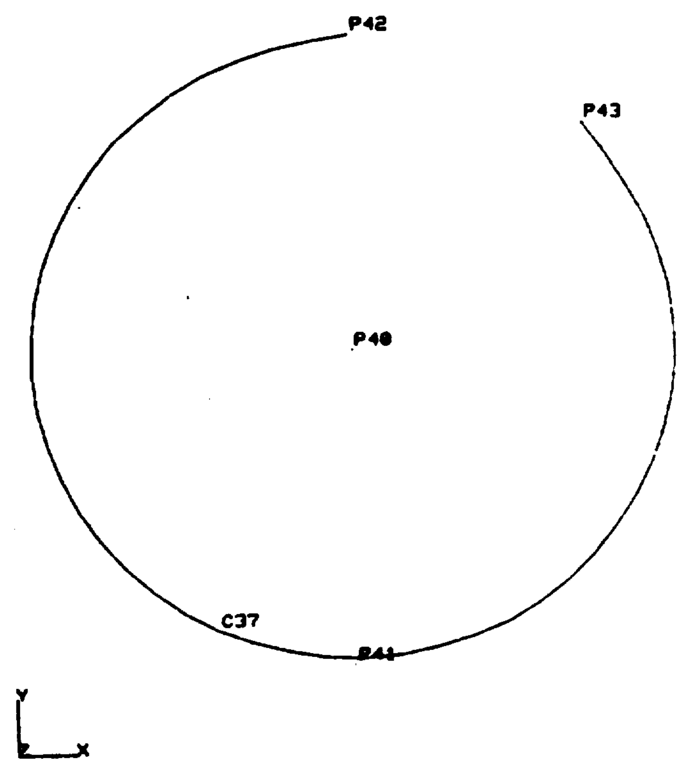

```
CURVE MENU

 1  LINE                    4  TWO SURFACE INTERSECTION    7  MERGE TWO CURVES
 2  CIRCLE                  5  POINT FILE                  8  PARABOLIC ARC
 3  CIRCULAR ARC            6  FIT POINT SEQUENCE          9  DELETE
```

Curve Construction - Circular Arc

```
 ENTER MENU COMMAND >>
3
CIRCULAR ARC
ENTER CURVE NAME >>
C37
MAKE INVISIBLE (Y/N)? >>

ENTER DEFINITION TYPE >>
  ("CEN"=CENTER)
  ("CIR"=CIRCUMFERENCE)
CIR
ENTER THE 2 ARC END POINTS >>
P42 P43
ENTER POINT ON ARC >>
P41
ALLOW UNEQUAL RADII (Y/N)? >>
Y
 ENTER MENU COMMAND >>
```



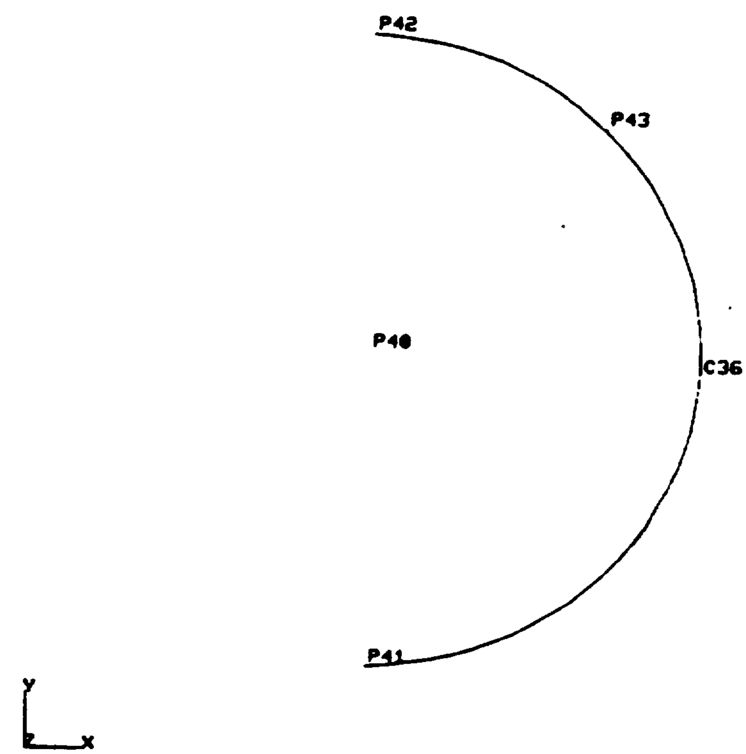

```
CURVE MENU

1  LINE                 4  TWO SURFACE INTERSECTION    7  MERGE TWO CURVES
2  CIRCLE               5  POINT FILE                  8  PARABOLIC ARC
3  CIRCULAR ARC         6  FIT POINT SEQUENCE          9  DELETE
```

Curve Construction - Circular Arc

```
 ENTER MENU COMMAND >>
3
CIRCULAR ARC
ENTER CURVE NAME >>
C36
MAKE INVISIBLE (Y/N)? >>

ENTER DEFINITION TYPE >>
  ('CEN'-CENTER)
  ('CIR'-CIRCUMFERENCE)
CIR
ENTER THE 2 ARC END POINTS >>
P41 P42
ENTER POINT ON ARC >>
P43
ALLOW UNEQUAL RADII (Y/N)? >>
Y
 ENTER MENU COMMAND >>
```



CURVE MENU

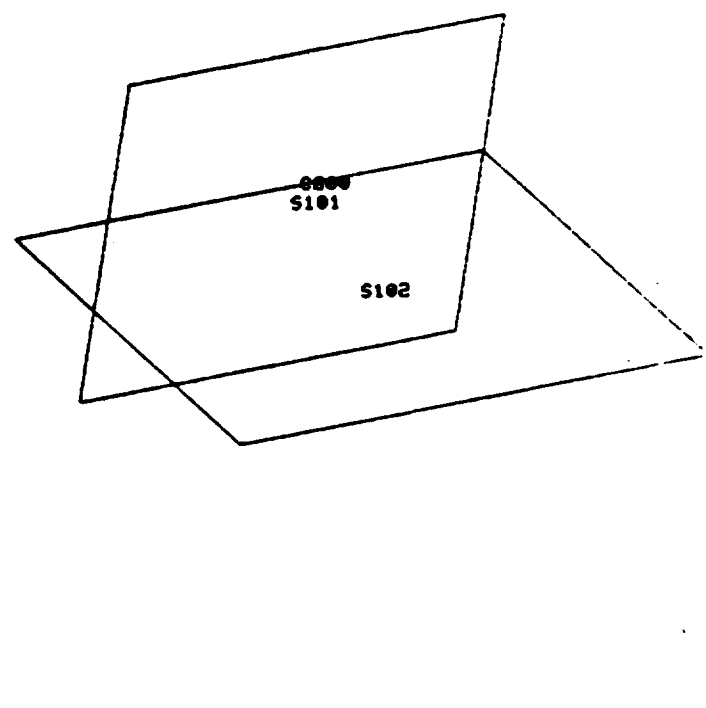
1 LINE
2 CIRCLE
3 CIRCULAR ARC

4 TWO SURFACE INTERSECTION
5 POINT FILE
6 FIT POINT SEQUENCE

7 MERGE TWO CURVES
8 PARABOLIC ARC
9 DELETE

Curve Construction - Two Surface Intersection

```
ENTER MENU COMMAND >>
4
TWO SURFACE INTERSECTION
ENTER CURVE NAME >>
C600
MAKE INVISIBLE (Y/N)? >>
ENTER THE 2 SURFACES >>
S101 S102
ENTER THE NUMBER OF POINTS TO
  EVALUATE ALONG THE CURVE >>
2
ENTER THE NUMBER OF BSPLINES
  REQUIRED TO FIT THE CURVE >>
1
ENTER MENU COMMAND >>
```




```
CURVE MENU

1 LINE                  4 TWO SURFACE INTERSECTION    7 MERGE TWO CURVES
2 CIRCLE                5 POINT FILE                  8 PARABOLIC ARC
3 CIRCULAR ARC          6 FIT POINT SEQUENCE          9 DELETE
```

Curve Construction - Point File

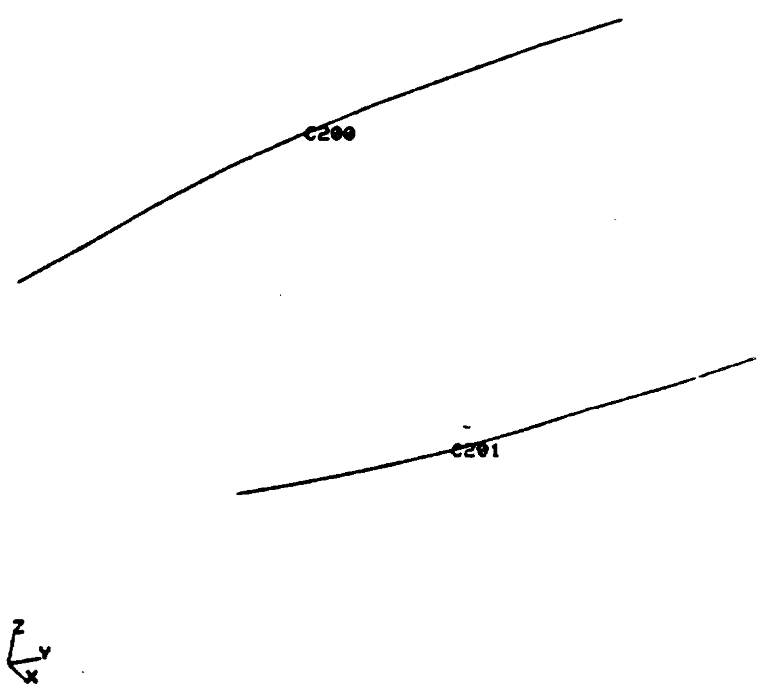
PTFIL.DATA

```
0,0,0
.5,1,1
1.5,2,2
2,0,0
2,1,0
3,2,1
```

```
 ENTER MENU COMMAND >>
5
POINT FILE
-- POINT FILE REQUIRED --
ENTER FILE NAME >>
AEECJHT.PTFIL.DATA
ENTER CURVE NAME >>
C200
MAKE INVISIBLE (Y/N)? >>

ENTER NUMBER OF POINTS TO
  SKIP IN THE POINT FILE >>
0
ENTER THE NUMBER OF POINTS TO
  EVALUATE ALONG THE CURVE >>
3
ENTER THE NUMBER OF BSPLINES
  REQUIRED TO FIT THE CURVE >>
1
 ENTER MENU COMMAND >>
5
POINT FILE
-- POINT FILE REQUIRED --
  -- DEFAULT FILE EXISTS --:
DEFAULT FILE IS AEECJHT.PTFIL.DATA
USE DEFAULT FILE (Y/N)? >>
Y
ENTER CURVE NAME >>
C201
MAKE INVISIBLE (Y/N)? >>

ENTER NUMBER OF POINTS TO
  SKIP IN THE POINT FILE >>
3
ENTER THE NUMBER OF POINTS TO
  EVALUATE ALONG THE CURVE >>
3
ENTER THE NUMBER OF BSPLINES
  REQUIRED TO FIT THE CURVE >>
1
 ENTER MENU COMMAND >>
```

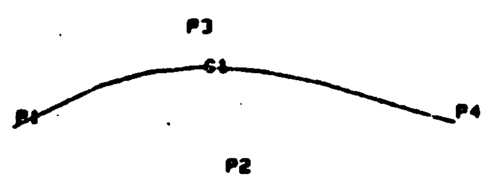



```
CURVE MENU

 1  LINE              4  TWO SURFACE INTERSECTION     7  MERGE TWO CURVES
 2  CIRCLE            5  POINT FILE                   8  PARABOLIC ARC
 3  CIRCULAR ARC      6  FIT POINT SEQUENCE           9  DELETE
```

Curve Construction - Fit Point Sequence

```
 ENTER MENU COMMAND >>
6
FIT POINT SEQUENCE
ENTER CURVE NAME >>
C1
MAKE INVISIBLE (Y/N)? >>
ENTER THE NUMBER OF POINTS TO
  EVALUATE ALONG THE CURVE >>
3
ENTER THE NUMBER OF BSPLINES
  REQUIRED TO FIT THE CURVE >>
1
ENTER POINTS ON CURVE >>
P1 P3 P4
 ENTER MENU COMMAND >>
```

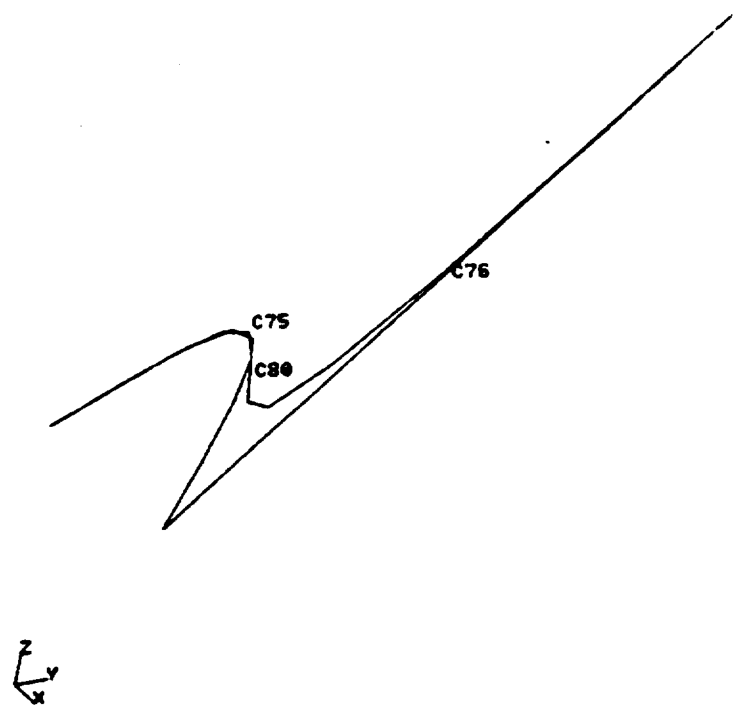



```
CURVE MENU

 1  LINE                  4  TWO SURFACE INTERSECTION     7  MERGE TWO CURVES
 2  CIRCLE                5  POINT FILE                   8  PARABOLIC ARC
 3  CIRCULAR ARC          6  FIT POINT SEQUENCE           9  DELETE
```

Curve Construction – Merge Two Curves

```
 ENTER MENU COMMAND >>
7
MERGE TWO CURVES
ENTER CURVE NAME >>
C80
MAKE INVISIBLE (Y/N)? >>
ENTER THE 2 CURVES TO JOIN >>
C75 C76
 ENTER MENU COMMAND >>
```



CURVE MENU

1	LINE	4	TWO SURFACE INTERSECTION	7	MERGE TWO CURVES
2	CIRCLE	5	POINT FILE	8	PARABOLIC ARC
3	CIRCULAR ARC	6	FIT POINT SEQUENCE	9	DELETE

Curve Construction - Parabolic Arc

```
 ENTER MENU COMMAND >>
8
PARABOLIC ARC
ENTER CURVE NAME >>
C20
MAKE INVISIBLE (Y/N)? >>

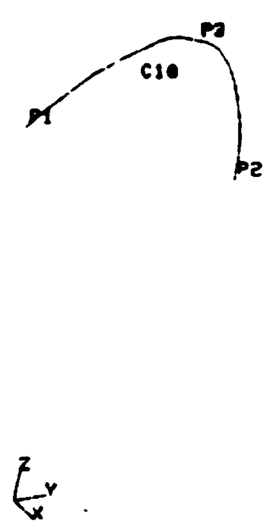
ENTER DEFINITION TYPE >>
   ('TAN'=TANGENT)
   ('VER'=VERTEX)
TAN
ENTER THE 2 ARC END POINTS >>
P2 P3
ENTER 1ST TANGENT (X,Y,Z) >>
1 1 1
ENTER 2ND TANGENT (X,Y,Z) >>
1 -1 1
 ENTER MENU COMMAND >>
```


```
CURVE MENU

 1  LINE                    4  TWO SURFACE INTERSECTION     7  MERGE TWO CURVES
 2  CIRCLE                  5  POINT FILE                   8  PARABOLIC ARC
 3  CIRCULAR ARC            6  FIT POINT SEQUENCE           9  DELETE
```

Curve Construction - Parabolic Arc

```
 ENTER MENU COMMAND >>
8
PARABOLIC ARC
ENTER CURVE NAME >>
C10
MAKE INVISIBLE (Y/N)? >>
ENTER DEFINITION TYPE >>
  ('TAN'=TANGENT)
  ('VER'=VERTEX)
VER
ENTER VERTEX POINT >>
P3
ENTER THE 2 ARC END POINTS >>
P1 P2
 ENTER MENU COMMAND >>
```

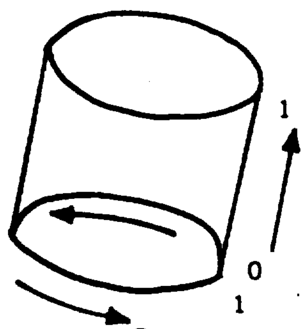



```
CURVE MENU

1 LINE                     4 TWO SURFACE INTERSECTION   7 MERGE TWO CURVES
2 CIRCLE                   5 POINT FILE                 8 PARABOLIC ARC
3 CIRCULAR ARC             6 FIT POINT SEQUENCE         9 DELETE
```

3.4 Surface Construction

There are nine ways available to construct surfaces in ESMOSS plus the option to delete a surface that has been previously defined. All surfaces consist of an "S" and a "T" direction with each of these parameters ranging from 0 to 1. A surface can be open in the S and T direction (e.g. a plane), closed in the S direction (e.g. a cylinder), or closed in the S and T direction (e.g. a sphere). A direction is considered closed if traversing it from start to finish brings you back to the starting point. For example, following the circumference of a circular cylinder will bring you back to the position at which you started, but following the length of the cylinder ends at a different position. A cylinder is then considered closed in the S direction, but open in the T direction.



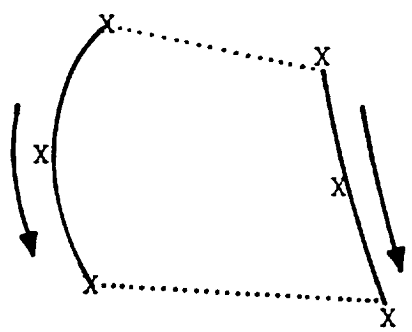
The first method of surface construction is to establish a surface by using a coordinate plane. The user must specify the fixed plane (X,Y, or Z), the value of that fixed plane and the bounds on the other two axis. This will result in a four sided surface.

The second method is a four point plane. The user inputs the four presiously defined corner points of the surface, which must be entered in a parallel manner (i.e. the two points on the top must be defined in the same direction as the two points on the base). If the four points are defined as one traverses the perimeter of the surface (clockwise or counterclockwise), a bow-tie type of surface will result. See the example for further details. The four point method is also the easiest method to define a 3 sided surface or triangle. The user must still specify four endpoints, but the last 2 points will be the same. For example, if points P1 and P2 establish the base and P3 the top of the triangle, then the required four points as input would be P1, P2, P3 and P3. This combination will generate a 3 sided surface.

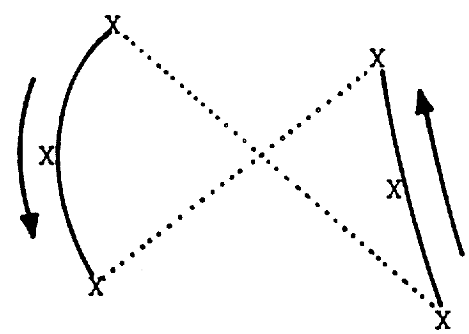
The third method is the generation of a circular cylinder. There are two variations of this definition. The user can specify the center of the base and the top and give the length of the radius or he can input a point on the circumference of the base and let the radius be computed.

The fourth option is similiar to the third and generates a frustrum. To construct a frustrum the user defines a point at the center of the base and on the center of the top. Two points are also required on the circumference, one on the base and one on the top. These four points are the minimum required to define the geometry.

A ruled surface is the fifth method of surface generation. It consists of two unique, open curves which have been previously defined in the same direction. A linear fit is performed between the endpoints of the two curves to form a surface. If the two curves are defined in opposite directions, a bow tie effect will appear instead of the desired surface.

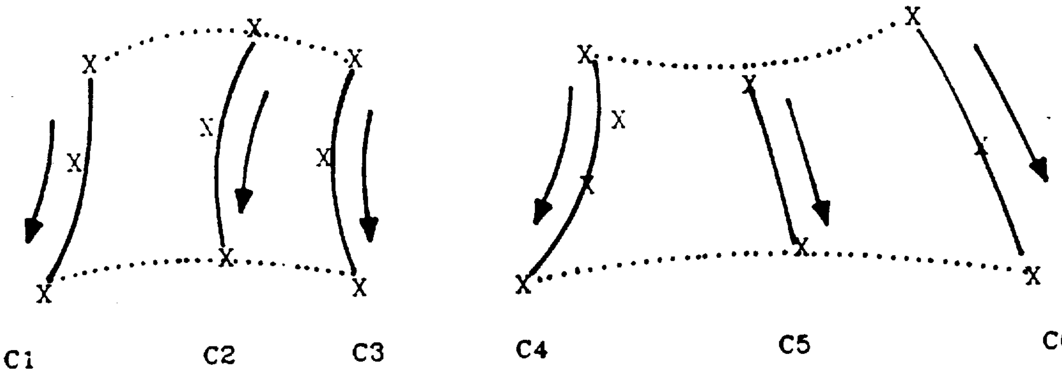


CORRECT METHOD
Both curves are defined in the same direction. The surface appears along the dotted lines.



INCORRECT METHOD
The curves are defined in opposite directions, thus a bow-tie surface will result, as shown above by the dotted lines.

A cubic B-surface is the most flexible method available for defining surfaces since the user has complete control over the contour of both the S and T directions. A surface is fitted using a number of curves. The user can specify up to 21 curves to generate the B-surface, however, all of them must have been previously defined. Since each curve must be defined by a set of points, ESMOSS checks each curve to determine how many control points exist. If one of the curves doesn't match the others as far as the number of control points is concerned, ESMOSS will redefine each input curve by a sequence of 16 points to use to construct the surface. This must be performed to enable ESMOSS to construct the B-surface. The original input curves will not be altered in any way. As in other methods of surface construction, the curves must all be defined in the same direction.



X = Control Points on the Defining Curves

NO CURVE RESTRUCTURING NECESSARY - All curves are defined with the same number of control points.

CURVE RESTRUCTURING IS REQUIRED TO FIT SURFACE - Curve 4 is defined with 4 control points, curve 5 with 2, and curve 6 with 3 control points. All curves must be re-evaluated and refitted with a default of 16 control points. The surface can then be constructed.

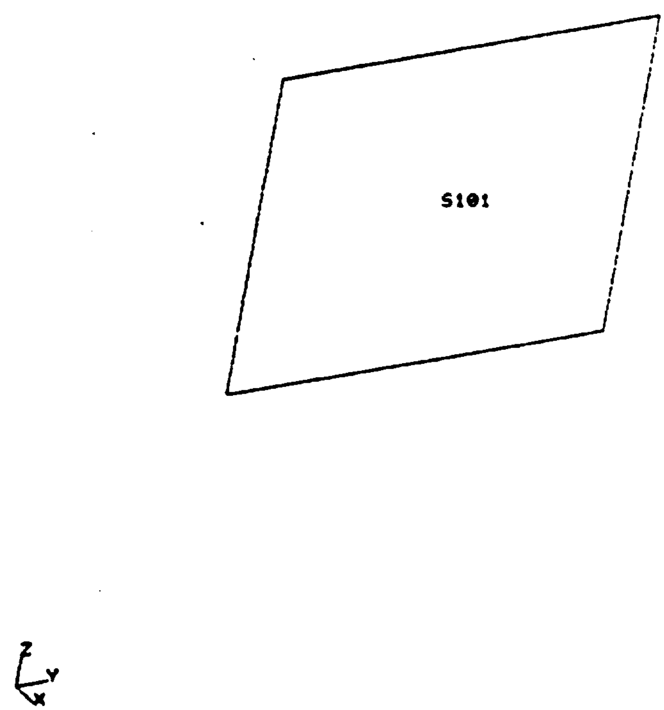
A surface can be trimmed or reduced by means of the subsurface patch option. The user must declare a parent surface that is to be trimmed and the new surface dimension. To define the new patch, four corner S and T values must be given, which can range from 0 to 1. A corner value of 0,0 will force one corner of the patch to reside at the starting corner of the surface, and a value of 1,1 will produce a point in the opposite corner. Values between 0 and 1 will give surface points inside the present surface. The four corner values must be defined in a parallel manner, (i.e. the first two corner values must be defined in the same direction as the last two corner values). If the four values are defined in a clockwise or counterclockwise fashion, a bow-tie surface will result.

Surfaces can also be defined from a data file of point coordinates in the same manner as points and curves. To allow greater flexibility in defining different types of surfaces, construction by curves will be simulated. The user will be prompted for the number of points in each curve that will be used to construct the surface and the number of curves in the surface. The number of B-splines in the direction of the curves and the number of cross-curve B-splines must be defined to produce the surface. Both of these numbers will usually be equal to the number of curves defined in the surface.

The final method of surface generation is the surface of revolution. Using this option, a surface is generated by revolving a predefined curve around the X, Y or Z axis. The user is asked to input the axis of revolution and the angle of revolution (0 - 360 degrees). If the angle is outside these limits, a default of 360 degrees will be substituted and a warning message printed. All rotation angles are measured clockwise about the origin when looking at the origin from a point on the positive side of the axis being rotated. For example, a rotation of 30 degrees about the Z axis should be interpreted as 30 degrees clockwise when looking at the origin from the positive end of the Z axis.

Surface Construction - Coordinate Plane

```
 ENTER MENU COMMAND >>
1
COORDINATE PLANE
ENTER SURFACE NAME >>
S101
MAKE INVISIBLE (Y/N)? >>
ENTER FIXED COORDINATE PLANE >>
X
ENTER FIXED COORDINATE VALUE >>
1
ENTER Y MINIMUM AND MAXIMUM >>
.5 2.5
ENTER Z MINIMUM AND MAXIMUM >>
0 1.75
 ENTER MENU COMMAND >>
```



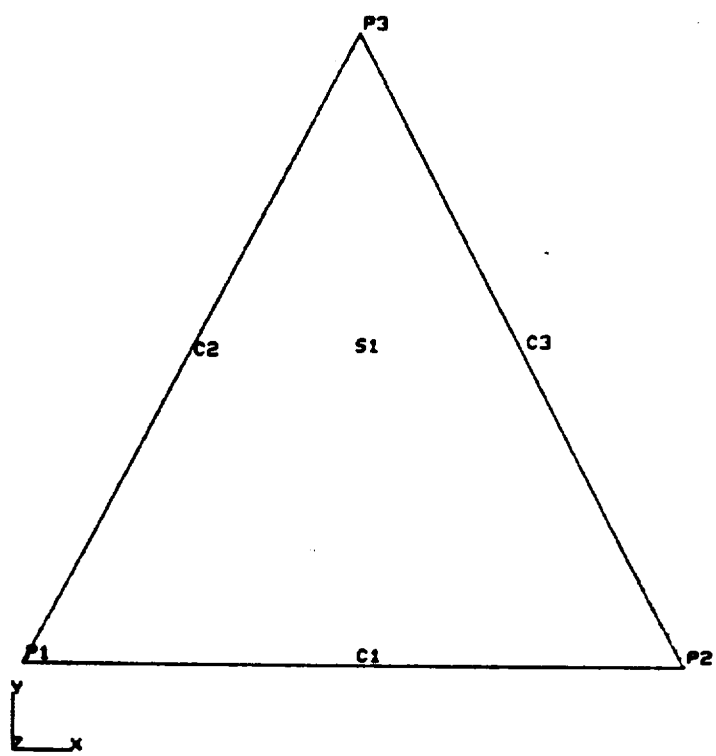

```
SURFACE MENU

 1  COORDINATE PLANE      5  RULED SURFACE          9  SURFACE OF REVOLUTION
 2  FOUR POINT PLANE      6  CUBIC BSURFACE         10 DELETE
 3  CIRCULAR CYLINDER     7  SUBSURFACE PATCH
 4  FRUSTRUM              8  POINT FILE
```

Surface Construction - Four Point Plane

```
 ENTER MENU COMMAND >>
2
FOUR POINT PLANE
ENTER SURFACE NAME >>
S1
MAKE INVISIBLE (Y/N)? >>

ENTER THE 4 CORNER POINTS >>
P1 P2 P3 P3
 ENTER MENU COMMAND >>
```

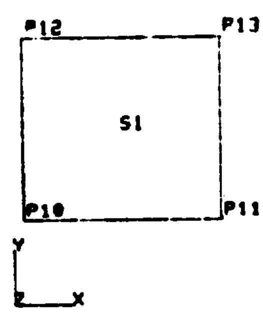


SURFACE MENU

1 COORDINATE PLANE
2 FOUR POINT PLANE
3 CIRCULAR CYLINDER
4 FRUSTRUM
5 RULED SURFACE
6 CUBIC BSURFACE
7 SUBSURFACE PATCH
8 POINT FILE
9 SURFACE OF REVOLUTION
10 DELETE

Surface Construction - Four Point Plane

```
 ENTER MENU COMMAND >>
2
FOUR POINT PLANE
ENTER SURFACE NAME >>
S1
MAKE INVISIBLE (Y/N)? >>
ENTER THE 4 CORNER POINTS >>
P10 P11 P12 P13
 ENTER MENU COMMAND >>
```



SURFACE MENU

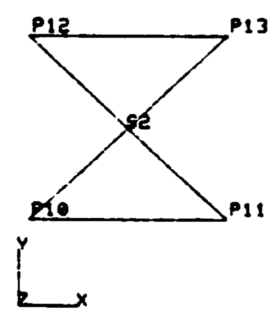
1 COORDINATE PLANE
2 FOUR POINT PLANE
3 CIRCULAR CYLINDER
4 FRUSTRUM
5 RULED SURFACE
6 CUBIC BSURFACE
7 SUBSURFACE PATCH
8 POINT FILE
9 SURFACE OF REVOLUTION
10 DELETE

Surface Construction - Four Point Plane

```
 ENTER MENU COMMAND >>
2
FOUR POINT PLANE
ENTER SURFACE NAME >>
S2
MAKE INVISIBLE (Y/N)? >>
ENTER THE 4 CORNER POINTS >>
P10 P11 P13 P12
 ENTER MENU COMMAND >>
```

** WRONG **

If points are defined in a clockwise or counterclockwise fashion as show below, a bow-tie surface will result. Points should be defined in a parallel order. (e.g. P10, P11, P12, P13)

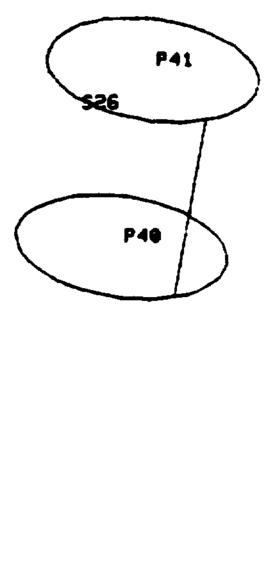



```
SURFACE MENU

 1  COORDINATE PLANE        5  RULED SURFACE          9  SURFACE OF REVOLUTION
 2  FOUR POINT PLANE        6  CUBIC BSURFACE        10  DELETE
 3  CIRCULAR CYLINDER       7  SUBSURFACE PATCH
 4  FRUSTRUM                8  POINT FILE
```

Surface Construction - Circular Cylinder

```
 ENTER MENU COMMAND >>
3
CIRCULAR CYLINDER
ENTER SURFACE NAME >>
S26
MAKE INVISIBLE (Y/N)? >>
ENTER DEFINITION TYPE >>
  ("R"=RADIUS VALUE)
  ("P"=POINT ON BASE)
R
ENTER CYLINDER RADIUS >>
.5
ENTER THE 2 AXIS END POINTS >>
P40 P41
 ENTER MENU COMMAND >>
```

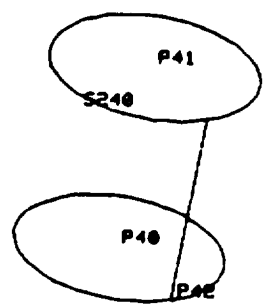



```
SURFACE MENU

1  COORDINATE PLANE
2  FOUR POINT PLANE
3  CIRCULAR CYLINDER
4  FRUSTRUM
5  RULED SURFACE
6  CUBIC BSURFACE
7  SUBSURFACE PATCH
8  POINT FILE
9  SURFACE OF REVOLUTION
10 DELETE
```

Surface Construction - Circular Cylinder

```
 ENTER MENU COMMAND >>
3
CIRCULAR CYLINDER
ENTER SURFACE NAME >>
S240
MAKE INVISIBLE (Y/N)? >>
ENTER DEFINITION TYPE >>
  ("R"-RADIUS VALUE)
  ("P"-POINT ON BASE)
P
ENTER POINT ON CYLINDER BASE >>
P42
ENTER THE 2 AXIS END POINTS >>
P40 P41
 ENTER MENU COMMAND >>
```

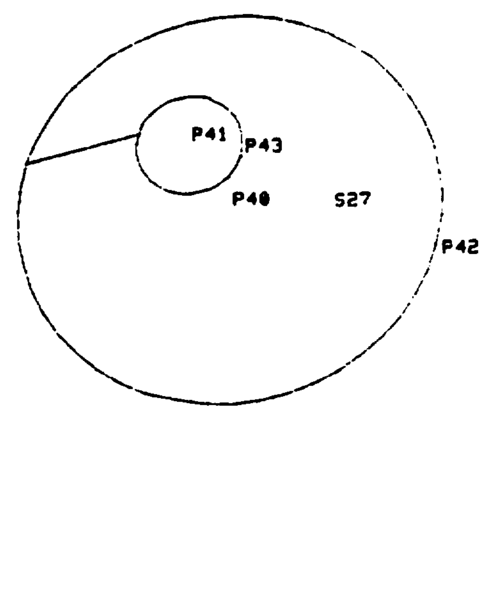


SURFACE MENU

```
1  COORDINATE PLANE      5  RULED SURFACE        9  SURFACE OF REVOLUTION
2  FOUR POINT PLANE      6  CUBIC BSURFACE       10 DELETE
3  CIRCULAR CYLINDER     7  SUBSURFACE PATCH
4  FRUSTRUM              8  POINT FILE
```

Surface Construction - Frustrum

```
ENTER MENU COMMAND >>
4
FRUSTRUM
ENTER SURFACE NAME >>
S27
MAKE INVISIBLE (Y/N)? >>
ENTER THE 2 AXIS END POINTS >>
P40 P41
ENTER POINT ON FRUSTRUM BASE >>
P42
ENTER POINT ON FRUSTRUM TOP >>
P43
ENTER MENU COMMAND >>
```

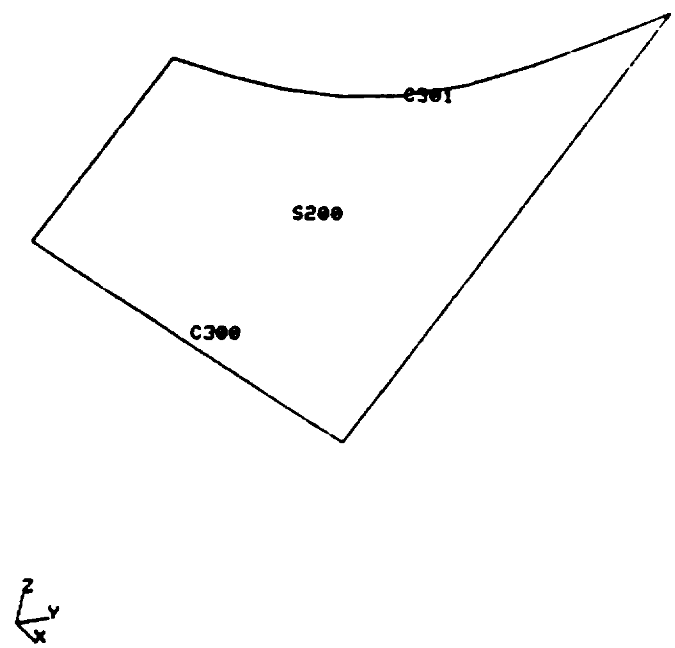


SURFACE MENU

1 COORDINATE PLANE
2 FOUR POINT PLANE
3 CIRCULAR CYLINDER
4 FRUSTRUM
5 RULED SURFACE
6 CUBIC BSURFACE
7 SUBSURFACE PATCH
8 POINT FILE
9 SURFACE OF REVOLUTION
10 DELETE

Surface Construction - Ruled Surface

```
 ENTER MENU COMMAND >>
5
RULED SURFACE
ENTER SURFACE NAME >>
S200
MAKE INVISIBLE (Y/N)? >>
ENTER THE 2 CURVES >>
C300 C301
 ENTER MENU COMMAND >>
```



SURFACE MENU

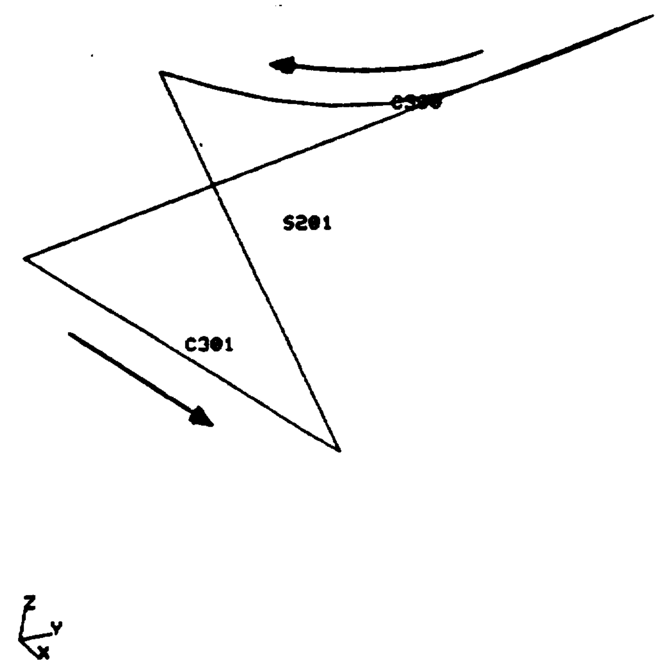
```
1  COORDINATE PLANE        5  RULED SURFACE          9  SURFACE OF REVOLUTION
2  FOUR POINT PLANE        6  CUBIC BSURFACE         10 DELETE
3  CIRCULAR CYLINDER       7  SUBSURFACE PATCH
4  FRUSTRUM                8  POINT FILE
```

Surface Construction - Ruled Surface

```
ENTER MENU COMMAND >>
5
RULED SURFACE
ENTER SURFACE NAME >>
S201
MAKE INVISIBLE (Y/N)? >>
ENTER THE 2 CURVES >>
C300 C301
ENTER MENU COMMAND >>
```

** WRONG **

If curves are defined in the opposite direction as shown below, a bow-tie surface will result. Curves should be defined in the same direction as on the previous page.

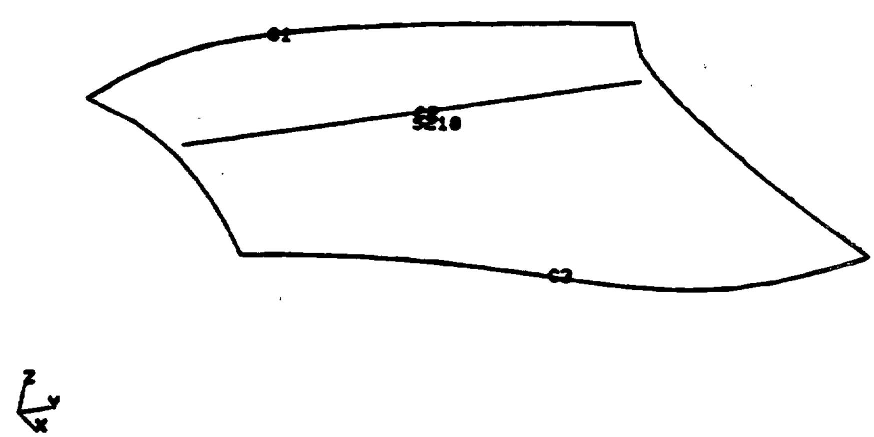



```
SURFACE MENU

1  COORDINATE PLANE        5  RULED SURFACE          9  SURFACE OF REVOLUTION
2  FOUR POINT PLANE        6  CUBIC BSURFACE         10 DELETE
3  CIRCULAR CYLINDER       7  SUBSURFACE PATCH
4  FRUSTRUM                8  POINT FILE
```

Surface Construction - Cubic Bsurface

```
ENTER MENU COMMAND >>
6
CUBIC BSURFACE
ENTER SURFACE NAME >>
S210
MAKE INVISIBLE (Y/N)? >>
ENTER NUMBER OF CURVES TO FIT >>
3
ENTER CURVES TO FIT >>
C1 C2 C3
ENTER # OF CURVE BSPLINES
3
ENTER # OF CROSS-CURVE BSPLINES >>
3
ENTER MENU COMMAND >>
```




```
SURFACE MENU

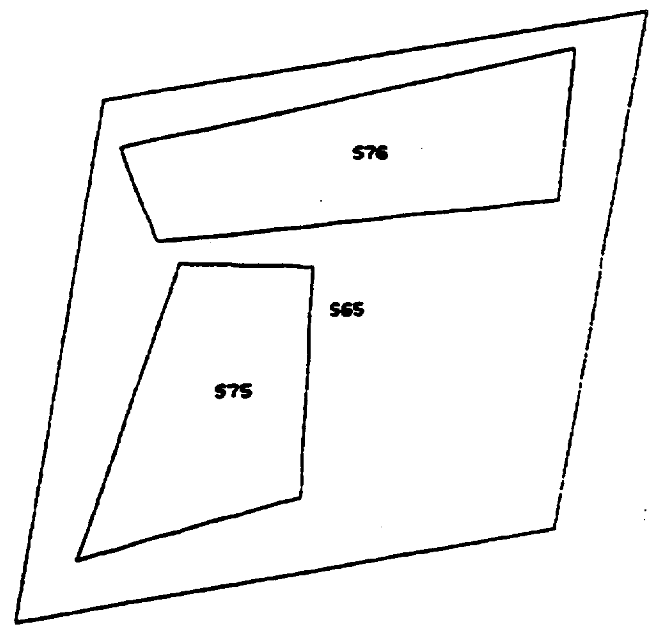
1 COORDINATE PLANE        5 RULED SURFACE          9 SURFACE OF REVOLUTION
2 FOUR POINT PLANE        6 CUBIC BSURFACE         10 DELETE
3 CIRCULAR CYLINDER       7 SUBSURFACE PATCH
4 FRUSTRUM                8 POINT FILE
```

Surface Construction - Subsurface Patch

```
 ENTER MENU COMMAND >>
7
SUBSURFACE PATCH
ENTER SURFACE NAME >>
S75
MAKE INVISIBLE (Y/N)? >>

ENTER THE PARENT SURFACE >>
S65
ENTER 4 PAIRS OF CORNER VALUES
.1 .1
.65 .2
.15 .5
.6 .45
 ENTER MENU COMMAND >>
7
SUBSURFACE PATCH
ENTER SURFACE NAME >>
S76
MAKE INVISIBLE (Y/N)? >>

ENTER THE PARENT SURFACE >>
S65
ENTER 4 PAIRS OF CORNER VALUES
.7 .15
.9 .05
.65 .9
.95 .88
 ENTER MENU COMMAND >>
```



SURFACE MENU

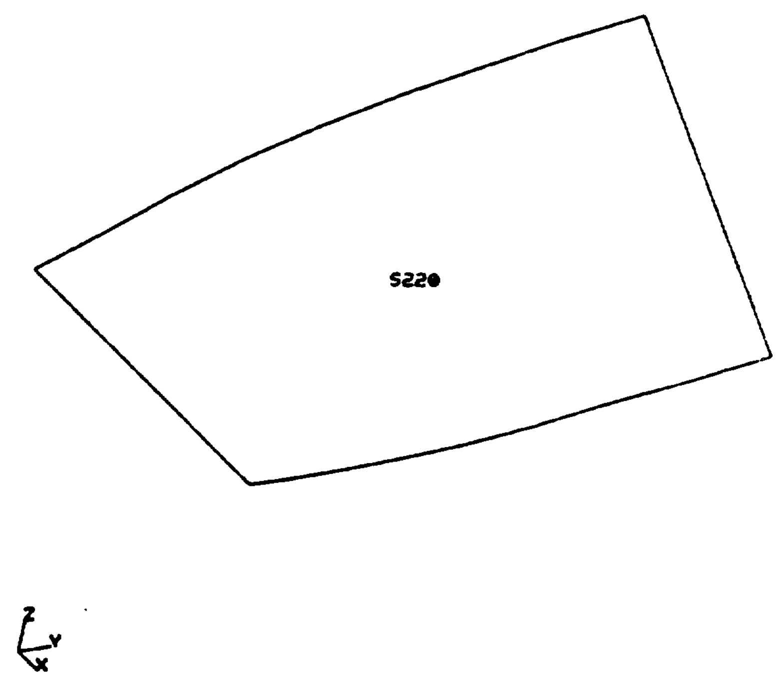
1 COORDINATE PLANE	5 RULED SURFACE	9 SURFACE OF REVOLUTION
2 FOUR POINT PLANE	6 CUBIC BSURFACE	10 DELETE
3 CIRCULAR CYLINDER	7 SUBSURFACE PATCH	
4 FRUSTRUM	8 POINT FILE	

Surface Construction - Point File

PTFIL.DATA

```
0,0,0
.5,1,1
1.5,2,2
2,0,0
2,1,0
3,2,1
```

```
ENTER MENU COMMAND >>
8
POINT FILE
-- POINT FILE REQUIRED --
  -- DEFAULT FILE EXISTS --:
DEFAULT FILE IS AEECJHT.PTFIL.DATA
USE DEFAULT FILE (Y/N)? >>
Y
ENTER SURFACE NAME >>
S220
MAKE INVISIBLE (Y/N)? >>
ENTER NUMBER OF POINTS TO
  SKIP IN THE POINT FILE >>
0
ENTER THE NUMBER OF
  POINTS IN EACH CURVE >>
3
ENTER THE NUMBER OF
  CURVES IN THE SURFACE >>
2
ENTER THE NUMBER OF
  CURVE DIRECTION BSPLINES >>
3
ENTER THE NUMBER OF
  CROSS-CURVE BSPLINES >>
2
ENTER MENU COMMAND >>
```

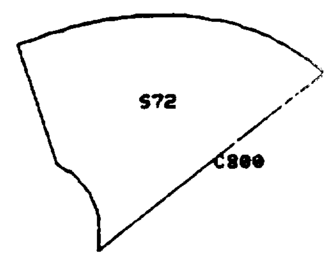


SURFACE MENU

```
1  COORDINATE PLANE        5  RULED SURFACE          9  SURFACE OF REVOLUTION
2  FOUR POINT PLANE        6  CUBIC BSURFACE         10 DELETE
3  CIRCULAR CYLINDER       7  SUBSURFACE PATCH
4  FRUSTRUM                8  POINT FILE
```

Surface Construction - Surface of Revolution

```
 ENTER MENU COMMAND >>
9
SURFACE OF REVOLUTION
ENTER SURFACE NAME >>
S72
MAKE INVISIBLE (Y/N)? >>
ENTER AXIS OF REVOLUTION (X/Y/Z) >>
X
ENTER CURVE TO BE REVOLVED >>
C800
ENTER ANGLE OF REVOLUTION >>
60
 ENTER MENU COMMAND >>
```



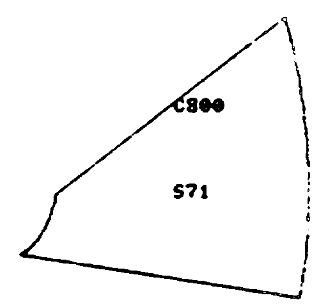
SURFACE MENU

1 COORDINATE PLANE	5 RULED SURFACE	9 SURFACE OF REVOLUTION
2 FOUR POINT PLANE	6 CUBIC BSURFACE	10 DELETE
3 CIRCULAR CYLINDER	7 SUBSURFACE PATCH	
4 FRUSTRUM	8 POINT FILE	

Surface Construction - Surface of Revolution

```
 ENTER MENU COMMAND >>
9
SURFACE OF REVOLUTION
ENTER SURFACE NAME >>
S71
MAKE INVISIBLE (Y/N)? >>

ENTER AXIS OF REVOLUTION (X/Y/Z) >>
Y
ENTER CURVE TO BE REVOLVED >>
C800
ENTER ANGLE OF REVOLUTION >>
45
 ENTER MENU COMMAND >>
```

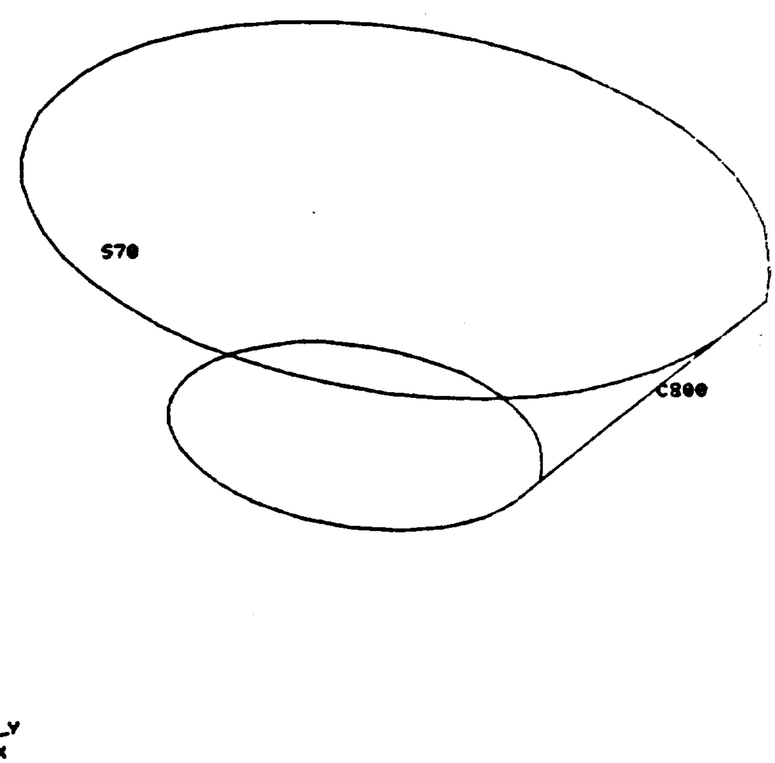



```
SURFACE MENU

 1  COORDINATE PLANE        5  RULED SURFACE          9  SURFACE OF REVOLUTION
 2  FOUR POINT PLANE        6  CUBIC BSURFACE        10  DELETE
 3  CIRCULAR CYLINDER       7  SUBSURFACE PATCH
 4  FRUSTRUM                8  POINT FILE
```

Surface Construction - Surface of Revolution

```
 ENTER MENU COMMAND >>
9
SURFACE OF REVOLUTION
ENTER SURFACE NAME >>
S70
MAKE INVISIBLE (Y/N)? >>
ENTER AXIS OF REVOLUTION (X/Y/Z) >>
Z
ENTER CURVE TO BE REVOLVED >>
C800
ENTER ANGLE OF REVOLUTION >>
360
 ENTER MENU COMMAND >>
```




```
SURFACE MENU

 1  COORDINATE PLANE        5  RULED SURFACE          9  SURFACE OF REVOLUTION
 2  FOUR POINT PLANE        6  CUBIC BSURFACE        10  DELETE
 3  CIRCULAR CYLINDER       7  SUBSURFACE PATCH
 4  FRUSTRUM                8  POINT FILE
```

3.5 Region Construction

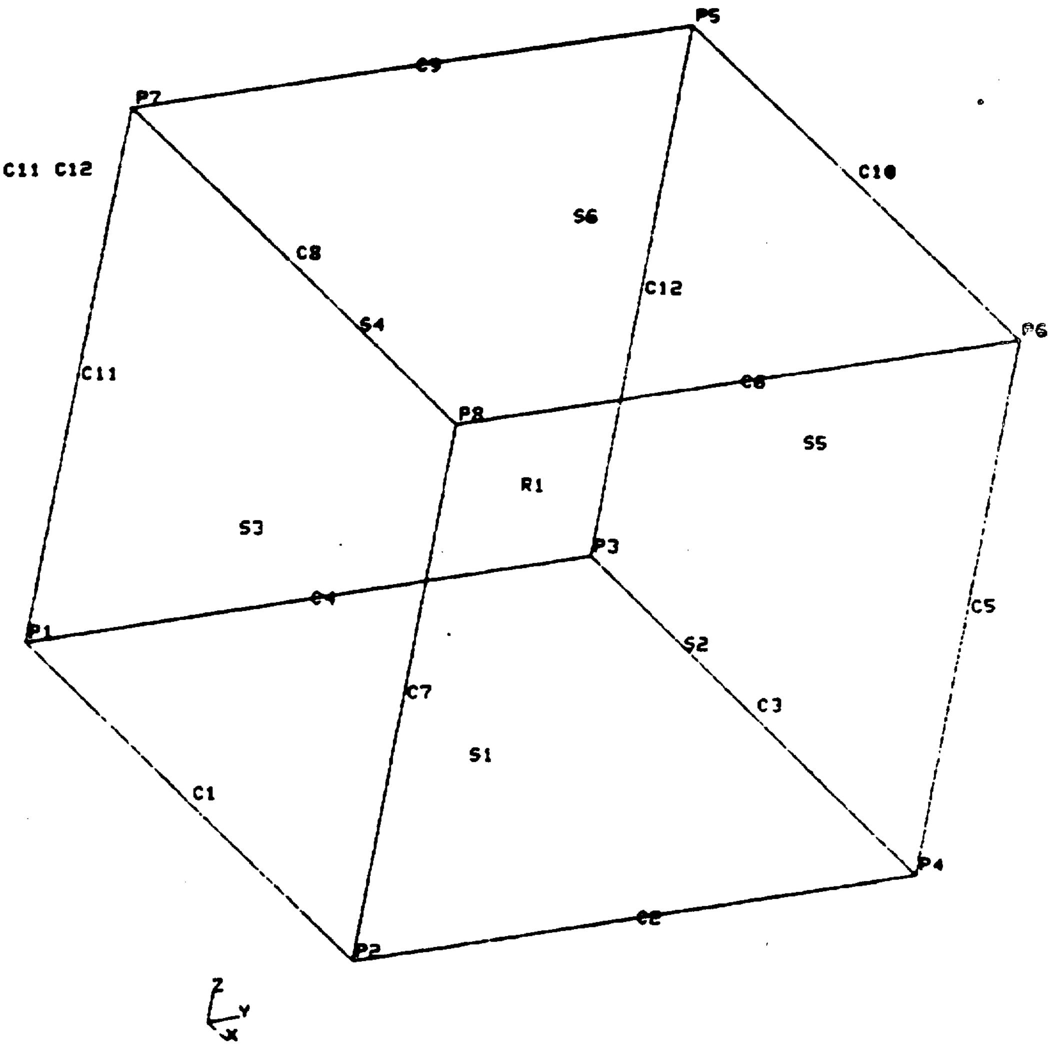
A region is a relational description of points, curves, and surfaces, which ESMOSS uses as input to the discretization processor. There are three basic types of regions: two-dimensional/4 sided, two-dimensional/3 sided and three-dimensional/6 sided. To define a region, the user must define the surface(s) that comprise the region, the curves that comprise the surfaces, and the points that define the curves. The surfaces are the faces of the region, the curves the edges, and the points the vertices. All of these entities must be defined and fit together to form a region. When ESMOSS requires face surfaces, edge curves, and vertex points as input, the necessary entities can be entered in any order. ESMOSS will check each entity to match it with the necessary other entities, thereby eliminating the need for the user to be concerned about ordering the sequence of input. However, all faces, edges, and vertices must match each other within tolerance.

An additional option that is available in this menu is the delete command which will remove a region which has been previously defined.

Region Construction - Three-Dimensional/Six-Sided

```
 ENTER MENU COMMAND >>
:
THREE-D SIX SIDED
ENTER REGION NAME >>
R1
MAKE INVISIBLE (Y/N)? >>

ENTER 6  FACE SURFACES >>
S1 S2 S3 S4 S5 S6
ENTER 12 EDGE CURVES >>
C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12
ENTER 8  VERTEX POINTS >>
P1 P2 P3 P4 P5 P6 P7 P8
 ENTER MENU COMMAND >>
```



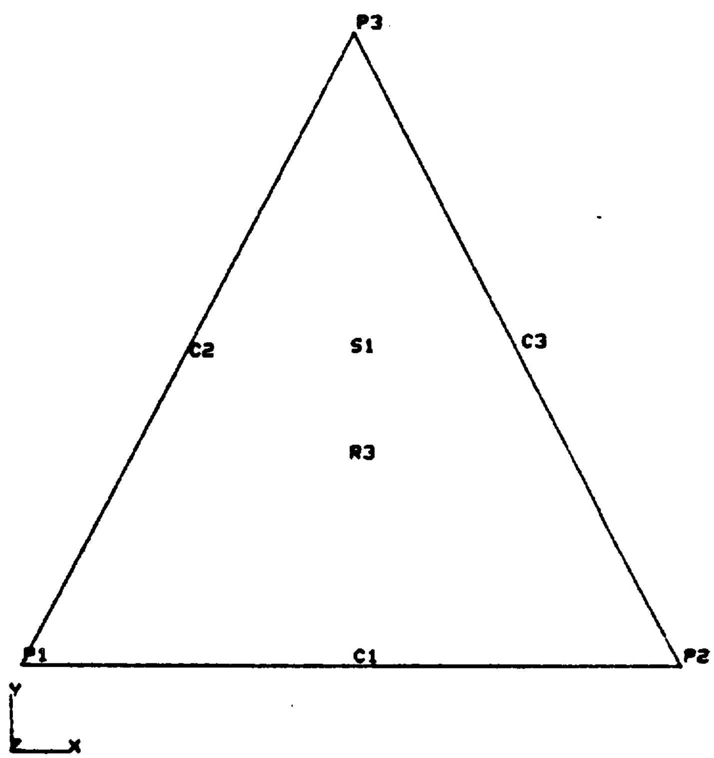

```
REGION MENU

 1  THREE-D SIX SIDED                3  TWO-D FOUR SIDED
 2  TWO-D THREE SIDED                4  DELETE
```

Region Construction - Two-Dimensional/Three-Sided

```
 ENTER MENU COMMAND >>
2
TWO-D THREE SIDED
ENTER REGION NAME >>
R3
MAKE INVISIBLE (Y/N)? >>

ENTER 1  FACE SURFACES >>
S1
ENTER 3  EDGE CURVES >>
C1 C2 C3
ENTER 3  VERTEX POINTS >>
P1 P2 P3
 ENTER MENU COMMAND >>
```

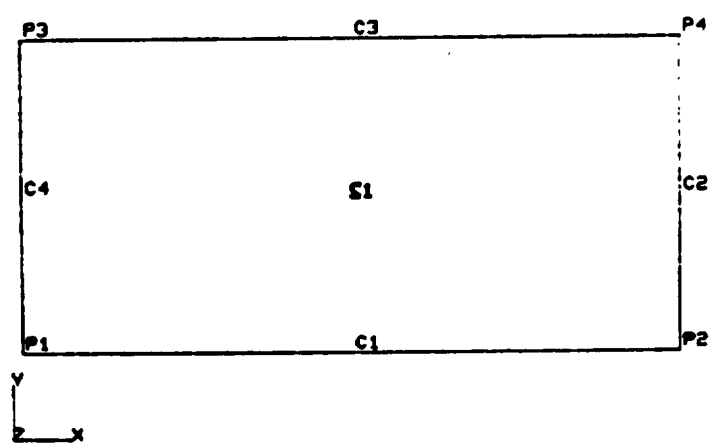



```
REGION MENU

 1  THREE-D SIX SIDED          3  TWO-D FOUR SIDED
 2  TWO-D THREE SIDED          4  DELETE
```

Region Construction - Two-Dimensional/Four-Sided

```
 ENTER MENU COMMAND >>
3
TWO-D FOUR SIDED
ENTER REGION NAME >>
R2
MAKE INVISIBLE (Y/N)? >>
ENTER 1  FACE SURFACES >>
S1
ENTER 4  EDGE CURVES >>
C1 C2 C3 C4
ENTER 4  VERTEX POINTS >>
P1 P2 P3 P4
 ENTER MENU COMMAND >>
```




```
REGION MENU

 1  THREE-D SIX SIDED          3  TWO-D FOUR SIDED
 2  TWO-D THREE SIDED          4  DELETE
```

3.6 Geometry Data File

The Geometry Data File that is generated by ESMOSS is a sequential file that can be examined and modified by the user. The format of the file is as follows. The first line contains the X,Y,Z minimum values and the second line the X,Y,Z maximum values for the plot boundaries on the screen. The rest of the file contains all of the points, curves, surfaces and regions that have been defined. All of the points are listed in numerical order, followed by curves, surfaces and regions.

Each entity is comprised of a header record and is followed by the <X,Y,Z> control points that define the entity. Each header record contains eight pieces of data. The first item determines the type of entity, a "1" denotes a point, "2" a curve, "3" a surface, and a "10" designates a region. The second item is the numeric part of the label (i.e. the entity number). Therefore, the first two items replace the name of the entity as it was defined in ESMOSS (e.g. P4 becomes a "1 4" in the data file, C241 becomes "2 241", S140 becomes "3 140", and R36 becomes "10 36". The third item is the subtype of the entity. The nine different types of subtypes are as follows.

0 - point
1 - open curve
2 - closed curve
3 - S and T open surface
4 - S closed, T open surface
5 - S open, T closed surface
6 - S and T closed surface
7 - 3-D 6 sided region
8 - 2-D 3 sided region
9 - 2-D 4 sided region

The fourth item is the number of dimensions that the entity can have, since all entities are 3-D geometry, this number will always be 3.

The last four items in the header record are S and T parameters for points, curves and surfaces. The first two represent the S and T input parameters to the B-spline fitting routines, and the last two are the S and T output parameters from the fitting routines. The S value always contains the number of control points that define the S contour, and the T value the number of control points that define the T contour. A point will always have four zeros since it has no S or T direction. A curve will always have a zero for the value of the T parameter since it has no T direction. A surface will have the S and T values that were assigned to it by ESMOSS. The S and T input values should always by equal to the S and T ouput values.

Regions have a different interpretation for the last four items in the header record. Since a region is comprised of point, curve and surface names only, there are no S and T values. Instead, the four numbers contain the following information about the region. the total number of names needed to define the region, the number of surfaces in the region, the number of curves, and finally the number of points in the region. In the example on the following page, the last entity contains the header record.

10 1 9 3 41 1 4 4.

The 10 identifies it as a region, the 1 as the first region (therefore, its name in ESMOSS was defined as R1), the 9 designates it as subtype 9, or a 2-D 4 sided region, the 3 means it contains 3-D information, the 41 means it has 41 pieces of data following the header to define the region, the 1 means it contains 1 surface, the 4, 4 curves, and the final 4 means it contains 4 points.

The information below the header describes how the region fits together. First, all surfaces are described, then curves and points. The first item of each line designates the entity to be related. For example, S1 is defined by four curves, the names of which follow (e.g. C4,C2,C1,C3). Since there is only 1 surface in this region, the curves are defined next. The four curves are defined as follows: the name of the curve (e.g. C1), the endpoints of the curve (e.g. P1, P2), and the surface on which they border (e.g. S1,S2). The last items to be related are points. They are defined by name (e.g. P1), and the curves that intersect to form the vertex point (e.g. C1,C4).

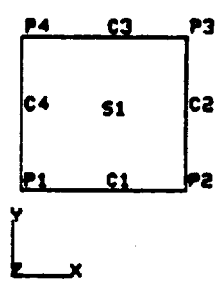
Finally, a "99" in the entity type position followed by 7 zeros is the end of file marker.

Geometry Data File Example

```
DATA.FILE
      0.0                  0.0                  0.0
      0.500000000E+01      0.600000000E+01      0.500000000E+01
             1         1         0         3         0         0         0         0
      0.0                  0.0                  0.0
             1         2         0         3         0         0         0         0
      0.100000000E+01      0.0                  0.0
             1         3         0         3         0         0         0         0
      0.100000000E+01      0.100000000E+01      0.0
             1         4         0         3         0         0         0         0
      0.0                  0.100000000E+01      0.0
             2         1         1         3         2         0         2         0
      0.0                  0.0                  0.0
      0.100000000E+01      0.0                  0.0
             2         2         1         3         2         0         2         0
      0.100000000E+01      0.0                  0.0
      0.100000000E+01      0.100000000E+01      0.0
             2         3         1         3         2         0         2         0
      0.100000000E+01      0.100000000E+01      0.0
      0.0                  0.100000000E+01      0.0
             2         4         1         3         2         0         2         0
      0.0                  0.0                  0.0
      0.0                  0.100000000E+01      0.0
             3         1         3         3         2         2         2         2
      0.0                  0.0                  0.0
      0.100000000E+01      0.0                  0.0
      0.0                  0.100000000E+01      0.0
      0.100000000E+01      0.100000000E+01      0.0
            10         1         9         3        41         1         4         4
 S1       C4       C2       C1      C3
 C1       P1       P2       S1
 C2       P2       P3       S1
 C3       P3       P4       S1
 C4       P1       P4       S1
 P1       C1       C4
 P2       C1       C2
 P3       C2       C3
 P4       C3       C4
          99         0         0         0         0         0         0         0
```

Model Created from Geometry Data File

```
 ENTER MENU COMMAND >>
1
DEFINE GEOMETRY FILE
-- GEOMETRY FILE REQUIRED --
ENTER FILE NAME >>
AEECJHT.DATA.FILE
 ENTER MENU COMMAND >>
```




```
GEOMETRY MODEL CONSTRUCTION MENU

1  DEFINE GEOMETRY FILE        4  SURFACE                       7  END
2  POINT                       5  REGIONS
3  CURVE                       6  INTERFACE GEOMETRIC MODELS
```

3.7 Geometric Model Interfacing

The option to interface geometric models allows the user to take two models that are stored in two separate data files and combine them into one model stored in one data file. Since the second model might not be constructed to fit the first model exactly, the user has the ability to rotate and translate the second model.

To interface two models from the Master Menu, select "3" to enter the Geometric Construction Menu and then a "1" to define the geometry file. This step defines the first model to be combined, but can be skipped if the user is already in the geometry menu and has constructed geometry. The option INTERFACE GEOMETRIC MODELS can now be selected and the appropriate questions will be asked to integrate the two models.

When the user selects the interface option, there must be a geometry file opened and active. ESMOSS will ask for the name of the second file and an output file to store the new model. The first and second file names can be the same if a model is to be copied or duplicated, but the output file name must be a unique name or the first model data will be destroyed.

After both files have been successfully accessed, the screen and menu will be refreshed and several questions will be asked. Because there is the possibility that each model may have entities with the same name, the entities from the second model must be renamed. The user will give a starting point for ESMOSS to start renaming each type of entity: points, curves, surfaces, and regions. For example, if model one has a point named P10, and model two contains the same name, this problem must be resolved. The user is prompted with the following:

```
EACH OF THE ENTITIES FROM THE 2ND MODEL
WILL BE RENAMED ACCORDING TO THE
STARTING VALUE SUPPLIED BY THE USER.
ALL VALUES PROCEED SEQUETIALLY
FROM THAT POINT --
WHAT IS THE STARTING VALUE
FOR POINTS (1 - 999)

WHAT IS THE STARTING VALUE
FOR CURVES (1 - 999)

WHAT IS THE STARTING VALUE
FOR SURFACES (1 - 250)

WHAT IS THE STARTING VALUE
FOR REGIONS (1 - 200)
```

For each of the above four questions, a value must be entered within the range of the numbers in parenthesis. The names of the first model always remains the same, only the second model names are restructured. If a new name value for the second model overlaps a name for the first model, the first model name will remain, and the next available name will be used. For example, if the following point names exist for both models and a starting value of 50 is given for the second model, then the new values will be generated as below.

Model 1.	Model 2:
P1 P3 P10 P52 P65	P1 P8 P17 P64 P675

Combined Model:

P1 P3 P10 P50 P51 P52 P53 P54 P55 P65

Points from model 2 are mapped as follows:

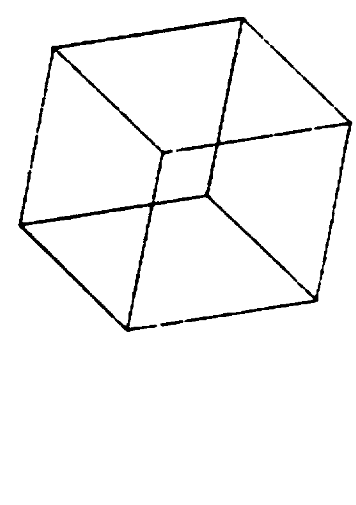
P1 ------> P50
P8 ------> P51
P17 ------> P53
P64 ------> P54
P675 ------> P55

Since P52 already exists from model 1, this point name is skipped, and the next available name is chosen, (i.e. P53).

The second model is now loaded into ESMOSS and prompts will be displayed for rotation and translation values to move the second model into its desired place. All rotation angle values should be in degrees, and the rotations are computed in the following order: rotation about X axis, Y axis, and then the Z axis. All rotation angles are measured clockwise about the origin when looking at the origin from a point on the axis.

Plot of Model A

ENTER MENU COMMAND >>

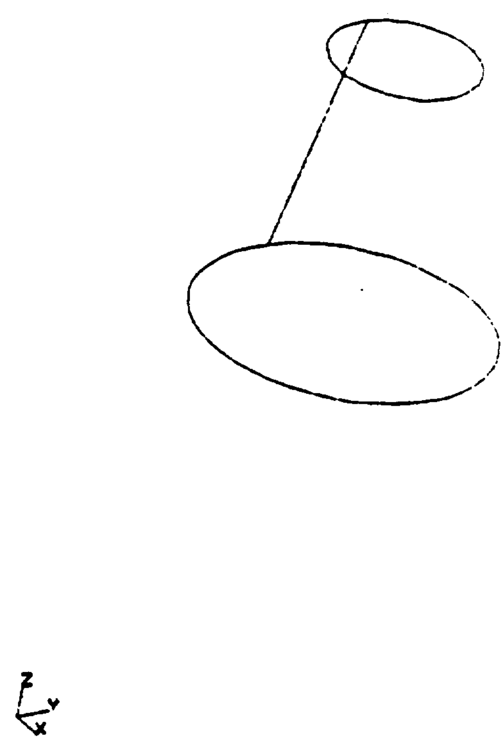


GEOMETRY MODEL CONSTRUCTION MENU

1 DEFINE GEOMETRY FILE
2 POINT
3 CURVE
4 SURFACE
5 REGIONS
6 INTERFACE GEOMETRIC MODELS
7 END

Plot of Model B

ENTER MENU COMMAND >>

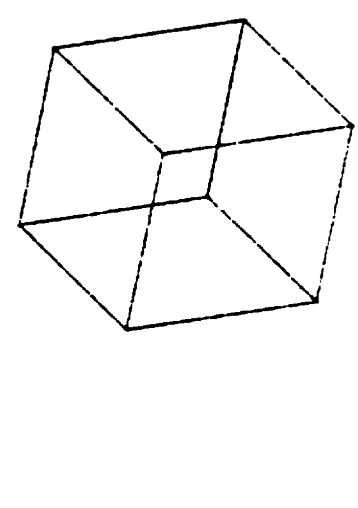


GEOMETRY MODEL CONSTRUCTION MENU

1 DEFINE GEOMETRY FILE
2 POINT
3 CURVE
4 SURFACE
5 REGIONS
6 INTERFACE GEOMETRIC MODELS
7 END

Model A Read in and Plotted

```
 ENTER MENU COMMAND >>
1
DEFINE GEOMETRY FILE
-- GEOMETRY FILE REQUIRED --
ENTER FILE NAME >>
AEECJHT.DATA.FILEC
 ENTER MENU COMMAND >>
6
INTERFACE GEOMETRIC MODELS
-- 2 ND GEOMETRY FILE REQUIRED --
ENTER FILE NAME >>
AEECJHT.DATA.FILED
-- DEFINE GEOMETRY OUTPUT FILE --
ENTER FILE NAME >>
AEECJHT.DATA.OUTF9
```

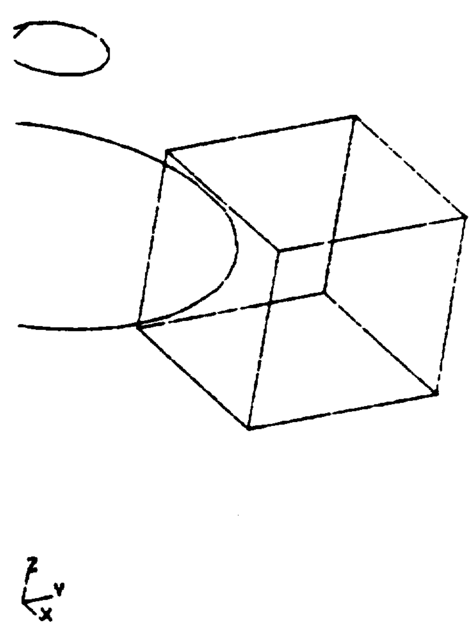


GEOMETRY MODEL CONSTRUCTION MENU

1 DEFINE GEOMETRY FILE	4 SURFACE	7 END
2 POINT	5 REGIONS	
3 CURVE	6 INTERFACE GEOMETRIC MODELS	

Model B is read in and plotted on top of Model A. The plotting boundaries are the same ones used for Model A. New boundaries are then input by the user and the rotated, translated models are then plotted after the screen is refreshed.

```
 EACH OF THE ENTITIES FROM THE 2ND MODEL
WILL BE RENAMED ACCORDING TO THE
STARTING VALUE SUPPLIED BY THE USER.
ALL VALUES PROCEED SEQUENTIALLY
FROM THAT POINT --
WHAT IS THE STARTING VALUE
FOR POINTS(1-999)
501
WHAT IS THE STARTING VALUE
FOR CURVES(1-999)
201
WHAT IS THE STARTING VALUE
FOR SURFACES(1-250)
101
WHAT IS THE STARTING VALUE
FOR REGIONS(1-50)
10
 INPUT THE X,Y,Z ROTATION VALUES
TO INTERFACE THE 2ND MODEL(X,Y,Z)
0 -90 0
INPUT THE X,Y,Z TRANSLATION VALUES
TO INTERFACE THE 2ND MODEL(X,Y,Z)
1 0 1
ENTER THE MODEL MINIMUM BOUNDS(X,Y,Z) >>
0 0 0
ENTER THE MODEL MAXIMUM BOUNDS(X,Y,Z) >>
3 3 3
```

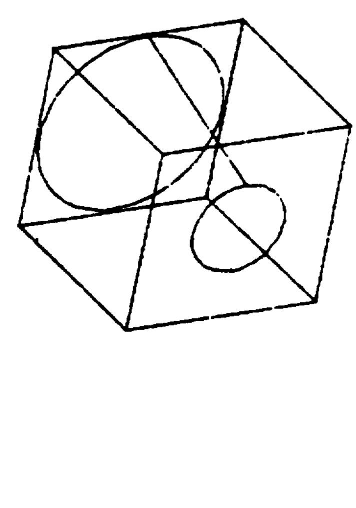



```
GEOMETRY MODEL CONSTRUCTION MENU

 1  DEFINE GEOMETRY FILE         4  SURFACE                        7  END
 2  POINT                        5  REGIONS
 3  CURVE                        6  INTERFACE GEOMETRIC MODELS
```

Model A, a cube has been combined
with Model B, a frustrum.
Using the rotations and translations
from the previous page, the original
position of the frustrum was altered
so that it now fits inside the cube.

ENTER MENU COMMAND >>



GEOMETRY MODEL CONSTRUCTION MENU

1 DEFINE GEOMETRY FILE
2 POINT
3 CURVE
4 SURFACE
5 REGIONS
6 INTERFACE GEOMETRIC MODELS
7 END

Data File for Model A

```
DATA.FILEC
     0.0             0.0             0.0
     0.300000000E+01 0.300000000E+01 0.300000000E+01
          1       1       0       3       0       0       0       0
     0.100000000E+01 0.0             0.0
          1       2       0       3       0       0       0       0
     0.200000000E+01 0.0             0.0
          1       3       0       3       0       0       0       0
     0.200000000E+01 0.100000000E+01 0.0
          1       4       0       3       0       0       0       0
     0.100000000E+01 0.100000000E+01 0.0
          1       5       0       3       0       0       0       0
     0.100000000E+01 0.0             0.100000000E+01
          1       6       0       3       0       0       0       0
     0.200000000E+01 0.0             0.100000000E+01
          1       7       0       3       0       0       0       0
     0.200000000E+01 0.100000000E+01 0.100000000E+01
          1       8       0       3       0       0       0       0
     0.100000000E+01 0.100000000E+01 0.100000000E+01
          2       1       1       3       2       0       2       0
     0.100000000E+01 0.0             0.0
     0.200000000E+01 0.0             0.0
          2       2       1       3       2       0       2       0
     0.200000000E+01 0.0             0.0
     0.200000000E+01 0.100000000E+01 0.0
          2       3       1       3       2       0       2       0
     0.200000000E+01 0.100000000E+01 0.0
     0.100000000E+01 0.100000000E+01 0.0
          2       4       1       3       2       0       2       0
     0.100000000E+01 0.100000000E+01 0.0
     0.100000000E+01 0.0             0.0
          2       5       1       3       2       0       2       0
     0.100000000E+01 0.0             0.100000000E+01
     0.200000000E+01 0.0             0.100000000E+01
          2       6       1       3       2       0       2       0
     0.200000000E+01 0.0             0.100000000E+01
     0.200000000E+01 0.100000000E+01 0.100000000E+01
          2       7       1       3       2       0       2       0
     0.200000000E+01 0.100000000E+01 0.100000000E+01
     0.100000000E+01 0.100000000E+01 0.100000000E+01
          2       8       1       3       2       0       2       0
     0.100000000E+01 0.100000000E+01 0.100000000E+01
     0.100000000E+01 0.0             0.100000000E+01
          2       9       1       3       2       0       2       0
     0.100000000E+01 0.0             0.0
     0.100000000E+01 0.0             0.100000000E+01
          2      10       1       3       2       0       2       0
     0.200000000E+01 0.0             0.0
     0.200000000E+01 0.0             0.100000000E+01
          2      11       1       3       2       0       2       0
     0.200000000E+01 0.100000000E+01 0.0
     0.200000000E+01 0.100000000E+01 0.100000000E+01
          2      12       1       3       2       0       2       0
     0.100000000E+01 0.100000000E+01 0.0
     0.100000000E+01 0.100000000E+01 0.100000000E+01
          3       1       3       3       2       2       2       2
     0.100000000E+01 0.0             0.0
```

```
  0.200000000E+01 0.0             0.0
  0.100000000E+01 0.100000000E+01 0.0
  0.200000000E+01 0.100000000E+01 0.0
        3       2       3       3       2       2       2       2
  0.100000000E+01 0.0             0.100000000E+01
  0.200000000E+01 0.0             0.100000000E+01
  0.100000000E+01 0.100000000E+01 0.100000000E+01
  0.200000000E+01 0.100000000E+01 0.100000000E+01
        3       3       3       3       2       2       2       2
  0.100000000E+01 0.0             0.0
  0.200000000E+01 0.0             0.0
  0.100000000E+01 0.0             0.100000000E+01
  0.200000000E+01 0.0             0.100000000E+01
        3       4       3       3       2       2       2       2
  0.200000000E+01 0.0             0.0
  0.200000000E+01 0.100000000E+01 0.0
  0.200000000E+01 0.0             0.100000000E+01
  0.200000000E+01 0.100000000E+01 0.100000000E+01
        3       5       3       3       2       2       2       2
  0.200000000E+01 0.100000000E+01 0.0
  0.100000000E+01 0.100000000E+01 0.0
  0.200000000E+01 0.100000000E+01 0.100000000E+01
  0.100000000E+01 0.100000000E+01 0.100000000E+01
        3       6       3       3       2       2       2       2
  0.100000000E+01 0.0             0.0
  0.100000000E+01 0.100000000E+01 0.0
  0.100000000E+01 0.0             0.100000000E+01
  0.100000000E+01 0.100000000E+01 0.100000000E+01
        10      1       7       3     122       6      12       8
S1      C4      C2      C1      C3
S2      C8      C6      C5      C7
S3      C9      C10     C1      C5
S4      C10     C11     C2      C6
S5      C11     C12     C3      C7
S6      C9      C12     C4      C8
C1      P1      P2      S1      S3
C10     P2      P6      S3      S4
C11     P3      P7      S4      S5
C12     P4      P8      S5      S6
C2      P2      P3      S1      S4
C3      P3      P4      S1      S5
C4      P4      P1      S1      S6
C5      P5      P6      S2      S3
C6      P6      P7      S2      S4
C7      P7      P8      S2      S5
C8      P8      P5      S2      S6
C9      P1      P5      S3      S6
P1      C1      C4      C9
P2      C1      C10     C2
P3      C11     C2      C3
P4      C12     C3      C4
P5      C5      C8      C9
P6      C10     C5      C6
P7      C11     C6      C7
P8      C12     C7      C8
        10      2       9       3      41       1       4       4
S1      C4      C2      C1      C3
C1      P1      P2      S1
C2      P2      P3      S1
C3      P3      P4      S1
C4      P4      P1      S1
P1      C1      C4
P2      C1      C2
P3      C2      C3
P4      C3      C4
        99      0       0       0       0       0       0       0
```

Data File for Model B

```
DATA.FILED
     -0.100000000E+01-0.100000000E+01-0.100000000E+01
      0.100000000E+01 0.100000000E+01 0.100000000E+01
            1       1       0       3       0       0       0       0
      0.500000000E+00 0.500000000E+00 0.0
            1       2       0       3       0       0       0       0
      0.500000000E+00 0.500000000E+00 0.100000000E+01
            1       3       0       3       0       0       0       0
      0.500000000E+00 0.100000000E+01 0.0
            1       4       0       3       0       0       0       0
      0.500000000E+00 0.750000000E+00 0.100000000E+01
            3       1       4       3      16       2      16       2
      0.0             0.499999821E+00 0.156989358E-06
      0.432271361E-01 0.703367889E+00 0.143416912E-06
      0.165434241E+00 0.871572018E+00 0.105046524E-06
      0.345490754E+00 0.975528002E+00 0.485126144E-07
      0.552263081E+00 0.997261047E+00-0.164095013E-07
      0.749998808E+00 0.933013320E+00-0.784942813E-07
      0.904507577E+00 0.793893874E+00-0.127006729E-06
      0.989073455E+00 0.603957534E+00-0.153558631E-06
      0.989074230E+00 0.396046162E+00-0.153558858E-06
      0.904509842E+00 0.206109226E+00-0.127007468E-06
      0.750002086E+00 0.669885278E-01-0.784953045E-07
      0.552266896E+00 0.273931026E-02-0.164107021E-07
      0.345494330E+00 0.244708061E-01 0.485114917E-07
      0.165437043E+00 0.128425419E+00 0.105045615E-06
      0.432286859E-01 0.296628594E+00 0.143416457E-06
      0.0             0.499996305E+00 0.156989358E-06
      0.250000358E+00 0.499993881E+00 0.100000000E+01
      0.271613896E+00 0.601683795E+00 0.100000000E+01
      0.332717359E+00 0.685785711E+00 0.100000000E+01
      0.422745526E+00 0.737763643E+00 0.100000000E+01
      0.526131511E+00 0.748630166E+00 0.100000000E+01
      0.624999225E+00 0.716506362E+00 0.100000000E+01
      0.702253461E+00 0.646946669E+00 0.100000000E+01
      0.744536340E+00 0.551978707E+00 0.100000000E+01
      0.744536757E+00 0.448023140E+00 0.100000000E+01
      0.702254593E+00 0.353054881E+00 0.100000000E+01
      0.625000834E+00 0.283494592E+00 0.100000000E+01
      0.526133418E+00 0.251370013E+00 0.100000000E+01
      0.422747314E+00 0.262235761E+00 0.100000000E+01
      0.332718790E+00 0.314212978E+00 0.100000000E+01
      0.271614671E+00 0.398314476E+00 0.100000000E+01
      0.250000358E+00 0.499998152E+00 0.100000000E+01
           99       0       0       0       0       0       0       0
```

DATA FILE FOR COMBINED MODELS

```
DATA.OUTF9
         0.0             0.0             0.0
         0.300000000E+01 0.300000000E+01 0.300000000E+01
                1       1       0       3       0       0       0       0
         0.100000000E+01 0.0             0.0
                1       2       0       3       0       0       0       0
         0.200000000E+01 0.0             0.0
                1       3       0       3       0       0       0       0
         0.200000000E+01 0.100000000E+01 0.0
                1       4       0       3       0       0       0       0
         0.100000000E+01 0.100000000E+01 0.0
                1       5       0       3       0       0       0       0
         0.100000000E+01 0.0             0.100000000E+01
                1       6       0       3       0       0       0       0
         0.200000000E+01 0.0             0.100000000E+01
                1       7       0       3       0       0       0       0
         0.200000000E+01 0.100000000E+01 0.100000000E+01
                1       8       0       3       0       0       0       0
         0.100000000E+01 0.100000000E+01 0.100000000E+01
                1     501       0       3       0       0       0       0
         0.100000000E+01 0.500000000E+00 0.500000000E+00
                1     502       0       3       0       0       0       0
         0.200000000E+01 0.500000000E+00 0.500000358E+00
                1     503       0       3       0       0       0       0
         0.100000000E+01 0.100000000E+01 0.500000000E+00
                1     504       0       3       0       0       0       0
         0.200000000E+01 0.750000000E+00 0.500000358E+00
                2       1       1       3       2       0       2       0
         0.100000000E+01 0.0             0.0
         0.200000000E+01 0.0             0.0
                2       2       1       3       2       0       2       0
         0.200000000E+01 0.0             0.0
         0.200000000E+01 0.100000000E+01 0.0
                2       3       1       3       2       0       2       0
         0.200000000E+01 0.100000000E+01 0.0
         0.100000000E+01 0.100000000E+01 0.0
                2       4       1       3       2       0       2       0
         0.100000000E+01 0.100000000E+01 0.0
         0.100000000E+01 0.0             0.0
                2       5       1       3       2       0       2       0
         0.100000000E+01 0.0             0.100000000E+01
         0.200000000E+01 0.0             0.100000000E+01
                2       6       1       3       2       0       2       0
         0.200000000E+01 0.0             0.100000000E+01
         0.200000000E+01 0.100000000E+01 0.100000000E+01
                2       7       1       3       2       0       2       0
         0.200000000E+01 0.100000000E+01 0.100000000E+01
         0.100000000E+01 0.100000000E+01 0.100000000E+01
                2       8       1       3       2       0       2       0
         0.100000000E+01 0.100000000E+01 0.100000000E+01
         0.100000000E+01 0.0             0.100000000E+01
                2       9       1       3       2       0       2       0
         0.100000000E+01 0.0             0.0
         0.100000000E+01 0.0             0.100000000E+01
                2      10       1       3       2       0       2       0
         0.200000000E+01 0.0             0.0
         0.200000000E+01 0.0             0.100000000E+01
```

```
         2        11          1          3          2          0          2          0
0.200000000E+01 0.100000000E+01 0.0
0.200000000E+01 0.100000000E+01 0.100000000E+01
         2        12          1          3          2          0          2          0
0.100000000E+01 0.100000000E+01 0.0
0.100000000E+01 0.100000000E+01 0.100000000E+01
         3         1          3          3          2          2          2          2
0.100000000E+01 0.0             0.0
0.200000000E+01 0.0             0.0
0.100000000E+01 0.100000000E+01 0.0
0.200000000E+01 0.100000000E+01 0.0
         3         2          3          3          2          2          2          2
0.100000000E+01 0.0             0.100000000E+01
0.200000000E+01 0.0             0.100000000E+01
0.100000000E+01 0.100000000E+01 0.100000000E+01
0.200000000E+01 0.100000000E+01 0.100000000E+01
         3         3          3          3          2          2          2          2
0.100000000E+01 0.0             0.0
0.200000000E+01 0.0             0.0
0.100000000E+01 0.0             0.100000000E+01
0.200000000E+01 0.0             0.100000000E+01
         3         4          3          3          2          2          2          2
0.200000000E+01 0.0             0.0
0.200000000E+01 0.100000000E+01 0.0
0.200000000E+01 0.0             0.100000000E+01
0.200000000E+01 0.100000000E+01 0.100000000E+01
         3         5          3          3          2          2          2          2
0.200000000E+01 0.100000000E+01 0.0
0.100000000E+01 0.100000000E+01 0.0
0.200000000E+01 0.100000000E+01 0.100000000E+01
0.100000000E+01 0.100000000E+01 0.100000000E+01
         3         6          3          3          2          2          2          2
0.100000000E+01 0.0             0.0
0.100000000E+01 0.100000000E+01 0.0
0.100000000E+01 0.0             0.100000000E+01
0.100000000E+01 0.100000000E+01 0.100000000E+01
         3       101          4          3         16          2         16          2
0.100000000E+01 0.499999821E+00 0.100000000E+01
0.100000000E+01 0.703367889E+00 0.956772864E+00
0.100000000E+01 0.871572018E+00 0.834565759E+00
0.100000000E+01 0.975528002E+00 0.654509246E+00
0.100000000E+01 0.997261047E+00 0.447736919E+00
0.100000000E+01 0.933013320E+00 0.250001192E+00
0.100000000E+01 0.793893874E+00 0.954924226E-01
0.100000000E+01 0.603957534E+00 0.109265447E-01
0.100000000E+01 0.396046162E+00 0.109257698E-01
0.100000000E+01 0.206109226E+00 0.954901576E-01
0.100000000E+01 0.669885278E-01 0.249997914E+00
0.100000000E+01 0.273931026E-02 0.447733104E+00
0.100000000E+01 0.244708061E-01 0.654505670E+00
0.100000000E+01 0.128425419E+00 0.834562957E+00
0.100000000E+01 0.296622594E+00 0.956771314E+00
0.100000000E+01 0.499996305E+00 0.100000000E+01
0.200000000E+01 0.499999881E+00 0.750000000E+00
0.200000000E+01 0.601683795E+00 0.728386462E+00
0.200000000E+01 0.685785711E+00 0.667282999E+00
0.200000000E+01 0.737763643E+00 0.577254832E+00
0.200000000E+01 0.748630166E+00 0.473868847E+00
```

```
 0.200000000E+01 0.716506362E+00 0.375001132E+00
 0.200000000E+01 0.646946669E+00 0.297746897E+00
 0.200000000E+01 0.551978707E+00 0.255464017E+00
 0.200000000E+01 0.448023140E+00 0.255463600E+00
 0.200000000E+01 0.353054881E+00 0.297745764E+00
 0.200000000E+01 0.283494592E+00 0.374999523E+00
 0.200000000E+01 0.251370013E+00 0.473866940E+00
 0.200000000E+01 0.262235761E+00 0.577253044E+00
 0.200000000E+01 0.314212978E+00 0.667281568E+00
 0.200000000E+01 0.398314476E+00 0.728385687E+00
 0.200000000E+01 0.499998152E+00 0.750000000E+00
      10         1         7         3       122         6        12         8
S1    C4     C2     C1     C3
S2    C8     C6     C5     C7
S3    C9     C10    C1     C5
S4    C10    C11    C2     C6
S5    C11    C12    C3     C7
S6    C9     C12    C4     C8
C1    P1     P2     S1     S3
C10   P2     P6     S3     S4
C11   P3     P7     S4     S5
C12   P4     P8     S5     S6
C2    P2     P3     S1     S4
C3    P3     P4     S1     S5
C4    P4     P1     S1     S6
C5    P5     P6     S2     S3
C6    P6     P7     S2     S4
C7    P7     P8     S2     S5
C8    P8     P5     S2     S6
C9    P1     P5     S3     S6
P1    C1     C4     C9
P2    C1     C10    C2
P3    C11    C2     C3
P4    C12    C3     C4
P5    C5     C8     C9
P6    C10    C5     C6
P7    C11    C6     C7
P8    C12    C7     C8
      10         2         9         3        41         1         4         4
S1    C4     C2     C1     C3
C1    P1     P2     S1
C2    P2     P3     S1
C3    P3     P4     S1
C4    P4     P1     S1
P1    C1     C4
P2    C1     C2
P3    C2     C3
P4    C3     C4
      99         0         0         0         0         0         0         0
```

4.0 DISCRETIZING GEOMETRIC MODELS

4.1 Introduction

The ESMOSS discretization library requires two files, a geometry file and a discrete data file, before a finite element model can be generated. The geometry file contains a regionalized description of the part in the form of cubic B-splines. The discrete data file can be created at the begining of a discretization session or it may contain a partially or completely discretized model. The user must ensure that an old discrete data file matches the geometry file.

4.2 Regionalized Model

ESMOSS discretizes a geometric model on a region by region basis. A model may contain up to 200 individual regions, each of which may be discretized (or rediscretized) without affecting the model as a whole. It is suggested that the user start discretizing at one end of the model and continue by operating on adjacent regions. This will prevent opposite edges from having conflicting numbers of nodes.

Presently, a geometric model can be divided using four different region types. Solid models must be divided into six- sided solid regions. Plate, shell or two-dimensional models may be divided into four-sided regular regions, four-sided irregular regions, or three-sided irregular regions or a combination of all three

4.2.1 Six-Sided Solid Regions

Solid 3-D models must be divided into regions composed of 8 vertices (geometric points), 12 edges (geometric curves), and 6 faces (geometric surfaces). Each edge may have its nodes biased independently allowing higher concentrations of nodes in high stress areas, however, opposite edges are required to have equal numbers of nodes. Presently, all solid models are discretized with eight-noded brick elements.

4.2.2 Two-dimensional Regular Regions

These are the simplest of the region types supported by ESMOSS. The region is a single face bounded by 4 vertices and 4 edges. As with the solid regions, opposite edges must have equal numbers of edge nodes, while biasing remains independent. Element types supported are corner-noded quadrilaterals and triangles.

4.2.3 Two-dimensional Irregular Regions

The irregular region removes the constraint that opposite edges must have equal numbers of nodes. Each edge is assigned a number of nodes and the program automatically transitions from an edge of high nodal density to one of low density. This allows the user greater flexibility placing nodes in areas suspected to have high deformation. Edge biasing is still permitted, but the choice of element type is triangular or "mostly" quadrilateral elements. Highly irregular regions will require at least a few triangular elements mixed among a grid of corner-noded quadrilaterals. ESMOSS supports both three-sided and four-sided irregular regions.

4.3 Relational Model

Communication between the geometry and discretization portions of ESMOSS is made via normalized shapes refered to as relational models. The relational model is simply a definition of the relationship of the regions of the model. The relational model is created and maintained by ESMOSS and is essentially invisible to the user. The model keeps track of which vertices, edges and faces form a region, where regions connect, which regions have been discretized and the manner in which discretization was executed. In short, the relational model frees the user from the many bookkeeping tasks which occur in the development of a finite element model.

4.3.1 Relational Model Description

Each region of a model is composed of a collection of geometric entities which may be created in a fairly general pattern. Order of creation, labeling and orientation are left to the user's convience. ESMOSS sorts this geometric information and rearanges it into indices such that discretization can occur in an efficient manner. The relational model then converts these indices into the geometric entity names which are recognized by the geometry library. The coordinates returned are then associated with their relational model index until a region is completely discretized.

4.3.2 Relational Model Definitions

The relational model defines the correspondence between the various geometric entities to their discrete counterparts in the following manner.

1) Region vertex points become discrete vertex nodes in a one to one manner.
2) Geometric curves which bound a region are discretized into

edge nodes. Edge nodes do not include the two bounding vertex nodes.

3) Geometric surfaces are discretized into face nodes. Again, the face nodes include only nodes on the surface itself, excluding both edge and vertex nodes.

4) The interior of a solid geometric region is discretized into interior or region nodes. These do not have a direct correspondence with any geometric entities but are derived by the discretization library.

The relational model ensures that adjacent regions, which are discretized at different times, do not have duplicate discrete entities. That is, a geometric vertex point which is part of more than one region becomes a single vertex node.

4.4 Discretization Procedure

After a regionalized geometric model has been created the discretization library of ESMOSS may be accessed. This is accomplished by selecting DISCRETE MODEL CONSTRUCTION from the ESMOSS Master Menu. The resulting menu, DEVELOP DISCRETE MODEL, offers a number of discrete model options. In this portion of the manual we are concerned with option number 1, DISCRETIZE GEOMETRIC MODEL.

4.4.1 Define Discretizing Files

The first step in the discretization process is the initialization of all buffers which will be accessed during the generation and storage of the finite element model. These arrays contain the information which makes up the relational model as well as providing operating space for the discretizing process. ESMOSS asks the user to input the names of the geometry file and the discrete data file. The geometry file must contain the regionalized geometry of the part to be discretized. As geometry information is read and stored in the appropriate buffers, each visible entity is displayed. The discrete data file may be old or new. If the file is old, the data contained must correspond to the selected geometry file, i.e. no changes can be made to a geometry file without creating a new discrete data file.

4.4.2 Display Model Status

This option allows the user to determine which regions, if any, have been previously discretized. ESMOSS queries the user for the region of interest (0 for all regions) and then accesses the relational model to determine the status of the region(s). The region number and its status are then printed.

4.4.3 Regionalized Model Plot

The user may request a regionalized plot of the part contained in the geometry file. This allows him to view all geometry of the part and the regions it has been divided into. Later, during the discretization, correct region numbers will required.

4.4.4 Discretize Region

Actual generation of the nodes and elements composing a finite element model occurs when DISCRETIZE REGION is selected. It is important to remind the user that ESMOSS discretizes on a region by region basis. While each region is not totally independent, a region can be discretized and rediscretized without effecting the remainder of the model. A partially discretized model can be saved, allowing the user to start during one session and finish during a later session without loss of effort.

4.4.4.1 Region Discretization Options

Presently, ESMOSS provides three discretizing options corresponding to the three acceptable region types (see Section 4.2). The first option, EIGHT NODED BRICKS, must be used with a three- dimensional solid region composed of 8 vertices, 12 edges, and 6 faces. This option results in finite element model composed of corner-noded brick elements.

The second option, REGULAR 2-D REGION, allows the discretization of regions composed of 4 vertices, 4 edges, and 1 face. The region may be planar, or three-dimensional and can be discretized with either corner noded quadrilateral elements or corner node triangles. This option restricts opposite edges to have equal numbers of nodes.

The primary difference between option 2 and 3, IRREGULAR 2-D REGION, is the elimination of the opposite edge restriction. Here, each edge of a region can have any number of nodes, with the variation distributed across the region's face. This added degree of freedom may result in a considerable bit of number crunching and should not be used indiscriminately. In addition, most regions will require the generation of at least a few triangular elements.

4.4.4.2 Selecting Region Number

After a region type has been selected, ESMOSS requests a specific region number. The program then runs a number of checks through access to the relational model. First, the discrete status of the region is checked. If the region has been previously discretized, the user is asked if he wishes to rediscretize the region. If he does, the bounding curves of the region are displayed and labeled.

The next check performed verifies that the region type agrees with the discretization option chosen. If a conflict is found, the user is informed and control is returned to menu level. Otherwise, the discritization of this region begins with the generation and/or display of vertex nodes. To ensure that duplicate vertex nodes do not occur, each geometric vertex point is checked to see if it has previously been discretized. This would occur if an adjacent region had been discretized.

ESMOSS next turns its attention to the region edges. Each edge is checked to see if it has previously been discretized as part of an adjacent region. If so, any existing edge nodes are added to the current region plot. For solid and 2-D regular regions any previously discretized edge causes the number of edge nodes to be propagated to all opposite edges on this region. Additionally, as a number of edge nodes is propagated, a check is made for conflecting numbers. Such an error could arise if discretization begins on one end of a model and then jumps to the other leaving one or more undiscretized regions in between. If this error occurs, control is returned to the menu level and the user is left with two options, in addition to starting over. If the model is solid, one of the regions containing a discretized edge must be rediscretized with the correct number of nodes. For 2-D models, the conflict can be also be resolved by discretizing this region as a 2-D irregular region. This approach will automatically transition from one number of nodes to another.

The final action before additional input is required is the display of all free edge names. For each set of opposite edges (or in the irregular case for all undiscretized edges) the edge number is displayed, and the user is informed that these edges are currently assigned zero edge nodes. Solid regions will cause groups of four edges to be displayed. 2D regular regions have sets of 2 edges, while the irregular regions display each free edge independently.

4.4.4.3 Setting Number of Edge Nodes

After all existing edge nodes have been displayed, ESMOSS prompts the user to input an edge name and the desired number of nodes to be generated along this edge (and any opposite edges). The routine first checks to see if the supplied edge number is part of the region currently being discretized. Next, a check is made to see if the edge is free or if a number of nodes has been defined. Given a free edge, the supplied number is propagated to all opposite edges and the user is prompted to input another edge name. If the edge is not free, the input number of nodes is checked against the number previously assigned to the edge. If the numbers match no error is generated and the redundant information is ignored. In either error situation a diagnostic message is printed and the user is prompted to input another edge name. If all edges have been set, or the user wishes to default any remaining edges to zero edge nodes, "0.0" is required as input.

4.4.4.4 Biasing of Edge Nodes

In models suspected of having stress concentrations, it is desirable to vary the mesh density from coarse in low stress areas to fine in areas of great stress. To accomplish this, while minimizing the number of regions, ESMOSS permits nodes to be biased along each edge. Unlike the number of edge nodes, biasing types and parameters are not propagated to opposite edges. The only restriction is that edges common to more than one region have consistent bias types and parameters.

To bias edge nodes, when prompted, the user supplies an edge name. The program then checks if this edge is part of the current region and, if so, requests a bias type and parameter. ESMOSS allows the user four biasing options:

1 = No Bias
This is the default option and produces equally spaced nodes along an edge. In this case the input bias parameter is ignored.

2 = End Bias
This option allows nodes to be packed closer to one end of an edge. When this option is chosen, the two bounding vertices are displayed and the user is asked toward which vertex should the nodes be packed. The input value is checked to ensure that it is part of the edge in question and, assuming it is, edge nodes are generated and displayed.

3 = Center Bias
In this case, nodes are symmetrically packed toward the center of the edge. The bias parameter determines how tightly the nodes are packed.

4 = Edge Bias
This bias type is the inverse of center bias. Nodes are symmetrically packed toward each vertex of an edge.

The bias parameter, which is required with each bias type, determines the magnitude at which edge nodes are to be packed. The parameter is read as a real number and must be greater than zero. The bias parameter is used such that a value of 2.0 places nodes twice as closely in the packed section as at the loose area, with a linear variation in between.

When the desired bias type and parameter has been applied to all edges of a region, ESMOSS requires the user input an edge number of "0" when prompted. After receiving this value, the program checks all edges of the current region to ensure that a bias type and parameter have been assigned. If an unbiased edge is found, the program defaults this edge to bias type number 1, no bias. This allows the user to worry only about those edges in which he wishes to alter the equally spaced node distributions.

Once the number of nodes, bias type, and bias parameter of an edge is defined ESMOSS then proceeds with the generation of nodal coordinates. To accomplish this, the discretization procedure must access the geometric library where the actual coordinates are generated. Geometry requires the edge number, the number of nodes to be generated, and an array containing the parametrized position ("S" factors) of each node along the edge. As an example, consider an arbitrary edge along which 3 equally spaced nodes are to be generated. The array of "S" factors would contain the real numbers 0.25, 0.50, and 0.75. It is a requirement that the "S" factor array start with the lowest value (greater than zero), and increase to the highest parameter (less than 1.0).

4.4.4.5 Face Node Generation

After all edge nodes have been plotted, ESMOSS begins the discretization of each face of the region. First, the program checks if the face has been previously discretized. If it has, the existing nodes are plotted. If not, the geometric library must again be accessed to generate face nodes. In this case, the discretization library provides a face number, number of face nodes to be generated, and two real arrays containing the parametrized position of each node on the face. These arrays contain "S" and "T" factors which were generated using the "S" factor arrays required to generate edge nodes. In this way, face node generation reflects the edge bias pattern without requiring additional input

4.4.4.6 Interior Node Generation

For solid models, ESMOSS employs a three-dimensional cubic Lagrangian shape function to generate interior nodal coordinates. This method parameterizes the solid region using 64 sets of coordinates (8 vertex nodes, 24 edge nodes and 24 face nodes, generated using the geometric library, and 8 interior nodes found iteratively). The parameters, in this case "S", "T", and "U", are calculated by weighing the six sets of "S" and "T" factors calcuated for each face of the region. In this manner, the interior nodes also reflect the edge bias pattern

4.4.4.7 Element Generation

Presently, ESMOSS supports three types of elements. For solid models, eight-noded brick elements are used. Two-dimensional or shell models can be discretized using either corner-noded quadrilaterals or corner-noded triangles. In each case, the element connectivity is counter-clockwise. When discretizing a regular 2-D region, the user has the option of all triangles or all quadrilaterals. When discretizing irregular regions, however, the user is restricted to triangles or mostly quadrilaterals with an occasional triangular element when necessary.

4.5 Saving Discrete Data

Prior to ending a discretization session the user must indicate whether he desires to save the newly generated discrete data. A yes answer causes the discrete data to be saved on the file that was indicated at the beginning of this discretization session. A negative answer terminates the discretization activity and any discrete data generated is lost.

4.5.1 Discrete Data File

The ESMOSS discrete data file contains three types of information. The first section contains the regionalized relational model information. This data is used whenever a region is rediscretized or when a partially completed model is finished. The second section of the file contains the nodal coordinates and element connectivity used to describe the discrete model. The third section contains the discrete model finalization data.

4.6 Discrete Model Interfacing

The Discrete Model Interfacing module of ESMOSS allows the user to take two discrete models stored in separate data files and combine them into one discrete model. The menu sequence to interface two discrete models is as follows.

MASTER MENU

1 EXECUTE COMMAND FILE
2 UTILITY COMMANDS
3 GEOMETRY MODEL CONSTRUCTION
* 4 DISCRETE MODEL CONSTRUCTION
5 RECIPE ENGINE PARTS
6 GENERATE ANALYSIS INPUT
7 FILE HANDLER
8 DONE

DEVELOP DISCRETE MODEL

1 DISCRETIZE GEOMETRIC MODEL
2 DISCRETE MODEL PLOT
* 3 INTERFACE DISCRETE MODELS
4 FINALIZE DISCRETE MODEL

INTERFACE DISCRETE MODELS

1 DEFINE MODEL FILES
2 MOVE NODE
3 ELIMINATE COMMON NODES
4 END

The following sections describe these four menu items in detail.

4.6.1 Define Model Files

This is the section that interfaces the two discrete models. ESMOSS asks the user for the names of the files that contain the two discrete models. Then ESMOSS asks the user for the X,Y,Z rotation and translation values to move the second model into its desired place. ESMOSS then asks the user for the starting node number for the second model and tells the user that the number must be greater than n, which is the largest node number for the first model. ESMOSS does the same thing for the starting element number for the second model. ESMOSS then uses these numbers to renumber the nodes and elements on the second model of the combined model to eliminate the chance of any duplicate node and element numbers.

4.6.2 Move Node

This module allows the user to move any node on the combined model. ESMOSS asks the user for the node to be moved and its new x,y,z coordinates.

4.6.3 Eliminate Common Nodes

This module allows the user to eliminate common nodes within a specified tolerance. ESMOSS asks the user for the tolerance and tells the user that 0.0001 is suggested.

4.6.4 End

End must be executed to get out of the Interface Discrete Models module. ESMOSS asks the user for the name of a discrete output file. Then ESMOSS asks the user if he wants to save the discrete data. If yes, the combined discrete model data will be written on the specified output file. If no, the combined discrete model data will be lost.

5.0 RECIPE PROCESSOR

5.1 Introduction

The Recipe Processor is a quick, easy method of generating geometric and discrete models with minimum user input. The geometric model can usually be generated by using a parametric representation of the data, thus eliminating the need for defining the geometry explicitly using the Geometric Model Construction menu. The Recipe Processor reads the recipe file, intreprets each line of the file and generates an ESMOSS command file.

A recipe is written as a program using its own high level programming language which allows the use of variable names and mathematical expressions such as Fortran. There is a set of reserved words that comprises the language of the recipe that can be used to create a model.

ABS	ACOS	AND	ARC	ARCCF	ASIN
ATAN	ATAN2	BIASCNTR	BIASEDGE	BIASEND	CIRCLE
CIRCLEC	COS	COSH	COTAN	CVPTFILE	CYLINDR
CYLINDRP	DEFINE	DELETECV	DELETEPT	DIM	DISEDGE
DIS2DIRG	DIS2DREG	DIS8NBRK	ELSE	END	ENDIF
ENDISCRT	ERF	ERFC	EXP	FRUSTRUM	GAMMA
IF	INCLUDE	INTRSECT	LGAMMA	LINE	LOG
LOG10	MAX	MIN	MOD	MRGCURVE	NOT
OR	PARABOLA	PARMCRV	PARMSRF	PLANE	PLANE4PT
POINT	PRINT	RADIAN	READ	REG2D4S	REG3D
REPEAT	REVOLVE	RULEDSRF	SETMODEL	SIGN	SIN
SINH	SQRT	SUBSURFC	TAN	TANH	THEN
TRUNC	UNTIL	WRITE			

The above words represent special functions to the Recipe Processor, and therefore, cannot be used as variable names or otherwise used in the recipe except for their specified purpose.

A line which begins with the characters "(*" is interpreted as a comment line; anything that follows these two consecutive characters will be ignored by the Recipe Processor.

5.2 Recipe Reserved Words

The following sections describe the reserved words allowed by the recipe processor. Following each description is an example of use.

5.2.1 ABS

The ABS is the absolute value function, and performs in the same manner as the Fortran Standard Function.

X = ABS (X)

5.2.2 ACOS

The ACOS is the Arccosine function, and performs in the same manner as the Fortran Standard Function.

X = ACOS (1)

5.2.3 AND

AND is a logical operator, and is used as a connective between two expressions. It can be used exactly the same as in Fortran.

IF (X < 10 AND Y =2)

5.2.4 ARC

The ARC command is used to construct geometry using circular arcs. The command has the same function as the arc command in the Geometry Construction Menu. The syntax is as follows, curve number, center point number, beginning point number, ending point number.

ARC (11,2,3,4)

5.2.5 ARCCF

The ARCCF command is used exactly the same as the ARC command, except that the arc is being constructed using three points on the arc; two end points and a point on the arc, instead of the previous method of two end points and a center point. This option adds greater flexibility in the Recipe Processor.

ARCCF (12,3,4,5)

5 2.6 ASIN

The ASIN is the Arcsine function and performs in the same manner as the Fortran Standard Function

X = ASIN (0)

5.2.7 ATAN

The ATAN is the Arctangent function and performs in the same manner as the Fortran Standard Function.

Z = ATAN (.5)

5.2.8 ATAN2

The ATAN2 is the Arctangent function with two parameters. The Y - axis must be the first arguement specified in the parameter list.

Z = ATAN2 (2/1)

5.2.9 BIASCNTR

The command BIASCNTR is part of the discretization options that lets the user bias the center of the edge. This allows more nodes to be concentrated toward the center of the edge. The syntax is as follows. the name of the edge, and the bias parameter.

BIASCNTR (2,.75)

5.2.10 BIASEDGE

The command BIASEDGE allows the user to concentrate more nodes toward both edges. This is the opposite of BIASCNTR. The syntax is as follows: name of edge, and the bias parameter.

BIASEDGE (3,.75)

5.2.11 BIASEND

The command BIASEND allows the user to bias the end of the edge. This allows more nodes to be concentrated toward the end of the edge. The syntax is as follows. the name of the edge, the bias parameter, and the vertex to bias toward.

BIASEND (4,.50,2)

5.2.12 CIRCLE

The CIRCLE command is used to construct circles using a center point and two points on the circle. The command has the same function as the circle command in the Geometry Construction Menu. The syntax is as follows: curve number, center point, two points on the circle.

CIRCLE (10,25,31,32)

5.2.13 CIRCLEC

The CIRCLEC command is used to construct circles using three points on the circumference of the circle. The command has the same function as the circle command above, except the syntax is three circumference points.

CIRCLEC (11,31,32,33)

5.2.14 COS

The COS is the Cosine function, and performs in the same manner as the Fortran Standard Function.

X = COS (.5)

5.2.15 COSH

The COSH is the Hyperbolic Cosine function, and performs in the same manner as the Fortran Standard Function.

Y = COSH (.9)

5.2.16 COTAN

The COTAN is the Cotangent function, and performs in the same manner as the Fortran Standard Function.

Z = COTAN (.5)

5.2.17 CVPTFL

The CVPTFILE command is used to construct a curve from a point file. It is important to note that if a recipe is executed using this command, the point file name must have already been opened by the File Handler as a point file. If the user fails to open this file before executing the command file generated by the recipe, the procedure will fail. The syntax is as follows: the number of the curve, the number of points to skip in the point file before reading points, the number of points to evaluate along the curve, and the number of B-splines required to fit the curve.

CVPTFILE (210,0,3,1)

5.2.18 CYLINDR

The CYLINDR command is used to contruct cylindrical geometry using the center point of the bottom, and the center point of the top of the cylinder. The radius of the cylinder is also required input to construct the geometry. The syntax is as follows: the number of the cylinder, the magnitude of the radius, the bottom center point of the cyclinder, and the top center point.

CYLINDR (2,.5,1,2)

5.2.19 CYLINDRP

The CYLINDRP command is used to construct cylindrical geometry using the center point of the bottom, and the center point of the top of the cylinder. A point on the circumference of the circular bottom is also needed to complete the required input. The CYLINDRP command performs the same function as the CYLINDR command except the CYLINDRP command uses a point on the circumference of the cylinder to compute the radius, whereas the CYLINDRP command gets the radius explicitly from the user. The syntax is as follows: the number of the cylinder, the point on the circumference, the center point of the bottom, and the center point of the top of the cylinder.

CYLINDRP (3,8,1,2)

5.2.20 DEFINE

The DEFINE command is used to create macros to perform a given function or group of instructions repeatedly. The command should be the first line of the macro and give a name to the procedure. The macro can be located anywhere inside of the recipe, but it must be placed before the first reference is made to it. The macro must then be terminated with an END statement to signal the conclusion of the procedure. To call or execute the macro in the recipe, simply type the name of the macro. There can be no parameters passed back and forth, and all variables are global. Below is an example of how to set up a macro and how to execute it.

```
DEFINE BOX
   POINT (P+1,XBOTLEFT,YBOTLEFT,0)
   POINT (P+2,XBOTLEFT,YBOTLEFT+WIDTH,0)
   POINT (P+3,XBOTLEFT+LENGTH,YBOTLEFT+WIDTH,0)
   POINT (P+4,XBOTLEFT+LENGTH,YBOTLEFT,0)
(*
   P=P+4
END BOX
P=0
SETMODEL (0,0,0,15,15,15)
XBOTLEFT = 1
YBOTLEFT = 1
LENGTH = 2
WIDTH = 2
BOX
(*
XBOTLEFT = 4
YBOTLEFT = 4
BOX
```

In the previous example, a 4 point square will be created twice. The first time, the lower left point will be at (1,1,0), and the second time (4,4,0). The use of the macro prevented the user from typing in the parametric equations repeatedly to create geometry.

5.2.21 DELETECV

The DELETECV command allows the user to delete a curve. The only parameter needed is the number of the curve to be deleted.

```
DELETECV(456)
```

5.2.22 DELETEPT

The DELETEPT command allows the user to delete a point. The only parameter needed is the number of the point to be deleted

DELETEPT (400)

5.2.23 DIM

The DIM obtains the positive difference between two numbers. The value of the function is A1 - A2 if A1 > A1, and 0 if A1 < A2. The function performs in the same manner as the Fortran Standard Function.

DIM (X1,Y1)

5.2.24 DISEDGE

The DISEDGE command permits the user to discretize an edge of a model and specify the number of nodes that are to be placed on the edge. The syntax is edge number and number of nodes to be placed on the edge.

DISEDGE (2,4)

5.2.25 DIS2DIRG

The DIS2DIRG command starts the procedure to discretize a 2 dimensional irregularly shaped region. The only parameter needed is the name of the region to be discretized.

DIS2DIRG (1)

5.2.26 DIS2DREG

The DIS2DREG command starts the procedure to discretize a 2 dimensional region. The only parameter needed is the name of the region to be discretized.

DIS2DREG (2)

5.2.27 DIS8NBRK

The DIS8NBRK command starts the procedure to discretize a 3 dimensional eight noded brick region. The only parameter needed is the name of the region to be discretized.

```
DIS8NBRK (3)
```

5.2.28 ELSE

The ELSE statement is used in the same manner as Fortran. When using and IF statement, the ELSE option can be used to indicate a section of code to be executed only when the IF test is false.

```
IF (X = 1)
THEN
   Y = 1
ELSE
   Y = 2
END IF
```

5.2.29 END

The END statment is used to end a procedure or the recipe itself. In the case of DEFINE, the END statment is followed by the name of the macro (e.g. END BOX), in the case of the recipe, the statement END RECIPE will terminate the recipe and return control from the recipe processor back to ESMOSS.

```
END RECIPE (end the recipe)
    or
END BOX  (end a macro)
```

5.2.30 ENDIF

The ENDIF statement is used to terminate an IF statement. Every IF statement must have an ENDIF to conclude the procedure, and in the case of nested IF statements, the first ENDIF will terminate the last IF statement started.

```
ENDIF
```

5.2.31 ENDISCRT

The ENDISCRT statement is used to terminate a discretization procedure When a region is discretized in the recipe, the action is started with a DIS2DREG, DIS2DIRG or DIS8NBRK statement. These statements, and the statements that follow them are used to identify the region to be discretized and to place the proper number of nodes on each edge of the region. The ENDISCRT is used to wrap up all these statements and to prepare for the next step. Each region discretization procedure must end with a ENDISCRT statement.

ENDISCRT

5.2.32 ERF

The ERF is the Error Function, and performs in the same manner as the IBM Fortran Function.

Y = ERF (X)

5.2.33 ERFC

The ERFC is another version of the Error Function, and performs in the same manner as the IBM Fortran Function.

Z = ERFC (X)

5.2.34 EXP

The EXP is the Exponential function, and performs in the same manner as the Fortran Standard Function.

Y = EXP(X)

5.2.35 FRUSTRUM

THE FRUSTRUM command is used to construct a frustrum using a point at the center of the top and bottom of the entity. and a point on the circumference of the top and the bottom. The command has the same function as the frustrum command in the Geometry Construction Menu. The syntax is as follows: surface number, the 2 axis end points, a point on the frustrum base, and a point on the frustrum top.

```
FRUSTRUM (4,1,2,8,9)
```

5.2.36 GAMMA

The GAMMA function performs in the same manner as the IBM Fortran Function.

```
Y = GAMMA (X)
```

5.2.37 IF

The IF statment is used to test on a condition and perform one function if a true condition is found, and perform another function if a false condition is found. The syntax follows the Fortran 77 convention.

```
IF ( A = 1)
THEN
  B = 2
END IF
```

or

```
IF (VAL = 11)
THEN
  XVAL = 2
  YVAL = 3
ELSE
  XVAL = 5
  YVAL = 5
END IF
```

5.2.38 INCLUDE

The INCLUDE command is used to include another file into the recipe command file. This command bring in another recipe or set of data to the current recipe that is being processed. Several files can be included at one time, the syntax is the INCLUDE statement followed by the file name in paranthesis, and then to terminate the INCLUDE process, and INCLUDE statement with no file name will revert back to processing other recipe commands.

```
INCLUDE (AEECJHT.FILE1.DATA)
INCLUDE (AEECJHT.FILE2.DATA)
INCLUDE (AEECJHT.FILE3.DATA)
INCLUDE
```

5.2.39 INTRSECT

The INTRSECT command is used to construct a curve from the intersection of two surfaces. The command has the same function as the intersect command in the Geometry Construction Menu. The syntax is as follows: the curve number, the number of the first surface, and the number of the second surface.

```
INTRSECT (12,202,203)
```

5.2.40 LGAMMA

The LGAMMA function is the natural log of the GAMMA function and performs in the same manner as the IBM Fortran Function.

```
Y = LGAMMA (X)
```

5.2.41 LINE

The LINE command is used to construct lines. The command has the same function as the line command in the Geometry Construction Menu. The syntax is as follows: the number of the line, the point number of the first and second end points.

```
LINE (11,1,2)
```

5.2.42 LOG

The LOG is the Natural Logarithm function, and performs in the same manner as the Fortran Standard Function.

Y = LOG (X)

5.2.43 LOG10

The LOG10 is the Common Logarithm function, and performs in the same manner as the Fortran Standard Function.

Y = LOG10 (X)

5.2.44 MAX

The MAX finds the maximum of two numbers, and performs in the same manner as the Fortran Standard Function.

HVAL = MAX (A,B)

5.2.45 MIN

The MIN finds the minimum of two numbers, and performs in the same manner as the Fortran Standard Function.

LVAL = MIN (C,D)

5.2.46 MOD

The MOD finds the remainder of the first arguement divided by the second arguement. It performs in the same manner as the Fortran Standard Function.

RVAL = MOD (X,3)

5.2.47 MRGCURVE

The MRGCURVE command is used to combine two previously defined curves The command has the same function as the merge curve command in the Geometry Construction Menu. The syntax is as follows. curve number, the number of the first and second curves to be joined. See the Geometry Construction Menu for further details.

MRGCURVE (41,51,52)

5.2.48 NOT

The NOT command is used to negate whatever comes immediately after it, and is used like the Fortran equivalent.

IF (NOT A = B)

5.2.49 OR

The OR command is a logical operator and is used as a connective between two expressions. It can be used exactly the same as in Fortran.

IF (X < 10 OR Y = 2)

5.2.50 PARABOLA

The PARABOLA command is used to construct parabolas using three points The command has the same function as the Geometry Construction Menu. The syntax is as follows: curve number, the vertex point number, and the two end point numbers.

PARABOLA (25,30,31,32)

5.2.51 PARMCRV

The PARMCRV command is used to construct a point from the parametric representation of a curve. The command has the same function as the Geometry Construction Menu. The syntax is as follows. the point number, the number of the curve to be used, and how far along the B-spline to travel to define the point.

PARMCRV (50,2,.25)

5.2.52 PARMSRF

The PARMSRF command is used to construct a point from the parametric representation of a surface. The command has the same function as the Geometry Construction Menu. The syntax is as follows: the point number, the number of the surface to be used, and how far along the B-surface to travel to define the point. The S direction is used first, and then the T direction.

PARMSRF (51,3,.5,.75)

5.2.53 PLANE

The PLANE command is used to construct a coordinate plane using one of the three coordinate axis as a fixed reference point. The command has the same function as the Geometry Construction Menu. The syntax is as follows: the surface number, the number of the axis (X = 1, Y = 2, Z = 3), the coordinate value of the axis, the two remaining coordinates needed to define the max and min bound for one axis, and the two coordinates needed to define the max and min bound for the remaining axis.

PLANE (6,3,2,3,6,4,7)
6 = surface number
3 = Z axis
2 = Z value is equal to 2
3 = minimum X value
6 = maximum X value
4 = minimum Y value
7 = maximum Y value

5.2.54 PLANE4PT

The PLANE4PT command is used to construct a plane from 4 end points. The command has the same function as the Geometry Construction Menu. The syntax is as follows: the surface number, and the numbers of the four end points.

PLANE4PT (1,1,2,4,3)

5.2.55 POINT

The POINT command is used to construct a point from (x,y,z) coordinate data. The command has the same function as the Geometry Construction Menu. The syntax is as follows. the point number, and the (x,y,z) coordinates.

POINT (1,.25,.5.1.25)

5.2.56 PRINT

The PRINT command is used to print out a prompt or message to the user of the recipe as it is being executed. The Recipe Processor prints out whatever text follows the PRINT statement.

PRINT INPUT CIRCLE RADIUS FOR FIRST CIRCLE

5.2.57 RADIAN

RADIAN is a function that will convert angles from degrees to radian measure.

RVAL = RADIAN (THETA)

5.2.58 READ

The READ command is used to read in data from the terminal, thereby allowing user input into the recipe as it is being processed. The READ statement also has the capacity to place a condition in paranthesis that will examine the user input and if it is not within the specified range, will return to the user for another prompt for correct values

READ THETA

or

READ THETA (THETA > 0 AND THETA <= 90)

(In this case, when a value for theta is read in from the terminal, the processor will check to see that THETA is between 0 and 90 degrees. If the value is not within these limits, then it will prompt the user again for correct input.)

5.2.59 REG2D4S

The REG2D4S command is used to generate a 2 dimensional, 4 sided region. The command requires as input: the number of the region to be formed, the number of the surface, 4 curves, and 4 points that comprise the region.

```
REG2D4S (1,1,1,2,3,4,1,2,3,4)       - name of region, 1 face surface
                                      4 edge curves, 4 vertex points
```

5.2.60 REG3D

The REG3D command is used to generate a 3 dimensional region. The command requires as input: the number of the region to be formed, the numbers of the 6 surfaces, 12 curves, and 8 points that comprise the region.

```
REG3D (1,1,2,3,4,5,6                  - name of region, 6 face surfaces
_      1,2,3,4,5,6,7,8,9,10,11,12     - 12 edge curves
_      1,2,3,4,5,6,7,8)               - 8 vertex points
```

5.2.61 REPEAT

The REPEAT command is used to signal the start of a group of statements that are to be executed more than once. These multiple execution statements are nested between the REPEAT and UNTIL commands.

```
REPEAT
```

5.2.62 REVOLVE

The REVOLVE command is used to construct surfaces of revolution. The command has the same function as the Geometry Construction Menu. The syntax is as follows: number of the surface, number of the axis to revolve around (1 = X axis, 2 = Y axis, 3 = Z axis), the number of the curve to be revolved, and the number of degrees to revolve.

```
REVOLVE (100,3,1,360)
```

5.2.63 RULEDSRF

The RULEDSRF command is used to construct ruled surfaces. The command has the same function as the Geometry Construction Menu. The syntax is as follows. the number of the surface, and the 2 curves to be ruled between.

RULEDSRF (101,40,41)

5.2.64 SETMODEL

The SETMODEL command is used to set the max/min bounds on the geometric model that is constructed. The syntax is the 3 (x,y,z) minimum coordinates, and the 3 (x,y,z) maximum coordinates. The coordinates can be either numbers, or variables , or expressions (e.g. X+10). This command must be the first command in the recipe before any geometry is defined (i.e. point, curves, surfaces, or regions).

SETMODEL (0,0,0,X,Y,Z+5)

5.2.65 SIGN

The SIGN command is used to return the sign of the arguement in the paranthesis. It performs in the same manner as the Fortran Standard Function.

S = SIGN (X)

5.2.66 SIN

The SIN is the Sine function, and performs in the same manner as the Fortran Standard Function.

Y = SIN (THETA)

5.2.67 SINH

The SINH is the Hyperbolic Sine function, and performs in the same manner as the Fortran Standard Function.

Y = SINH (X)

5.2.68 SQRT

The SQRT is the Square root function, and performs in the same manner as the Fortran Standard Function.

```
SQ = SQRT(X)
```

5.2.69 SUBSURFC

The SUBSURFC command is used to construct a sub-surface patch from a parent surface that has been previously defined. The command has the same function as the Geometry Construction Menu. The syntax is as follows: the number of the surface, the number of the parent surface, and the 4 pairs of S and T parameters to define the boundary points of the sub-surface. Each of the S and T parameters can range from 0 to 1, with one being the beginning of a curve, and a 1 being the end of a curve. See the Geometry Construction Menu documentation for further details and explanation.

```
SUBSURFC (5,1,.1,.1,.9,.1,.1,.9,.9,.9)
```

5.2.70 TAN

The TAN is the Tangent function, and performs in the same manner as the Fortran Standard Function.

```
Y = TAN (THETA)
```

5.2.71 TANH

The TANH is the Hyperbolic Tangent function, and performs in the same manner as the Fortran Standard Function.

```
Z = TANH (X)
```

5.2.72 THEN

The THEN command is used to specify the true condition of an IF statement. In the syntax, the THEN statement immediately follows the IF statement, and it precedes the line which contains the true condition.

```
IF (A = B)
THEN
  X = 1
END IF
```

5.2.73 TRUNC

The TRUNC command is used to truncate a value so that only the integer value remains.

```
A = TRUNC (B)
```

5.2.74 UNTIL

The UNTIL command is used to terminate a group of statements that are to be executed until a condition is satisfied. The UNTIL statement is the end counterpart of the REPEAT statement.

```
UNTIL (X > 10)
```

5.2.75 WRITE

The WRITE command is used to print out information to the terminal. The PRINT statement will only print out what comes after it in the line, but the WRITE statement will print the value of a variable.

```
WRITE X1
WRITE Y1
```

6.0 DISCRETE MODEL FINALIZATION

6.1 Introduction

The Discrete Model Finalization module of ESMOSS allows the user to enter element property data, material property data (including temperature data), constraint data, and loading data to a previously discretized model.

The menu sequence to finalize a discrete model is as follows:

MASTER MENU

1 EXECUTE COMMAND FILE
2 UTILITY COMMANDS
3 GEOMETRY MODEL CONSTRUCTION
* 4 DISCRETE MODEL CONSTRUCTION
5 RECIPE ENGINE PARTS
6 GENERATE ANALYSIS INPUT
7 FILE HANDLER
8 DONE

DEVELOP DISCRETE MODEL

1 DISCRETIZE GEOMETRIC MODEL
2 DISCRETE MODEL PLOT
3 INTERFACE DISCRETE MODELS
* 4 FINALIZE DISCRETE MODEL

FINALIZE DISCRETE MODEL

1 DEFINE DISCRETE FILE
2 ADD FINALIZED DATA
3 CHANGE FINALIZED DATA
4 END

The following sections describe these four menu items in detail.

6.2 Define Discrete File

ESMOSS asks for a discrete file. Enter the fully qualified file name of the discrete model to finalize. Define Discrete File must be executed before finalized data can be added or changed.

6.3 Add Finalized Data

The menus under Add Finalized Data are:

ADD FINALIZED DATA

1 ELEMENT PROPERTY DATA	3 CONSTRAINT DATA
2 MATERIAL PROPERTY DATA	4 LOADING DATA

ADD ELEMENT PROPERTY DATA

1 SOLID FROM FILE	5 AXISYMMETRIC FROM FILE
2 SOLID FROM TERMINAL	6 AXISYMMETRIC FROM TERMINAL
3 SURFACE FROM FILE	7 PROPERTY POINTERS FILE
4 SURFACE FROM TERMINAL	8 PROPERTY POINTERS TERMINAL

ADD MATERIAL PROPERTY DATA

1 ISOTROPIC MATERIAL FILE	6 TEMPERATURE REFERENCES TERMINAL
2 ISOTROPIC MATERIAL TERMINAL	7 TABULAR FUNCTION FILE
3 ORTHOTROPIC MATERIAL FILE	8 TABULAR FUNCTION TERMINAL
4 ORTHOTROPIC MATERIAL TERMINAL	9 NODAL TEMPERATURES FILE
5 TEMPERATURE REFERENCES FILE	10 NODAL TEMPERATURES TERMINAL

ADD CONSTRAINT DATA

1 SINGLE POINT FILE	3 MULTIPLE POINT FILE
2 SINGLE POINT TERMINAL	4 MULTIPLE POINT TERMINAL

ADD LOADING DATA

1 LOAD AT NODE-FILE	4 MOMENT AT NODE-TERM
2 LOAD AT NODE-TERM	5 PRESSURE ON FACE-FILE
3 MOMENT AT NODE-FILE	6 PRESSURE ON FACE-TERM

The following pages describe the specific information required from the user for each of these menu items. The user has the option of entering each type of data from a file or from the terminal. To enter data from the terminal, the user need only follow the directions printed at the terminal. For each set or record of data, integer data is asked for at the first prompt, and real data is asked for at the second prompt. To enter data from a file, the user must follow the file format given for each type of data. The finalized data can be on one file or divided into several files as the user desires. The order of the data on the file(s) must follow the order of the menu items of file input selected. Any data entered interactively will not interrupt this order.

Each set of data has an identification number associated with it. ESMOSS takes care of this numbering automatically, beginning each set of each type of data with an identification number of one.

There are certain real data values that are optional for NASTRAN. These items are marked on the following pages. In these cases, blank values are valid. Using ESMOSS, it's not possible to enter a blank value interactively if a number is expected. It is possible to get around this. A blank value in the IBM is stored as 0.25098. To enter blank values from the terminal, the user must enter 0.25098. To enter blank values from a file, the user can enter either 0.25098 or ' '.

6.3.1 Entering Element Property Data

6.3.1.1 Entering Solid Element Data

The user must enter two pieces of data for each set of solid element data:

I) Element type (1 - 8 noded brick, 4 - 20 noded brick)
J) Material identification number

The maximum number of solid element sets is fifty.

FILE FORMAT

N N = Number of sets

I_1, J_1
I_2, J_2
.
.
.
I_N, J_N

6.3.1.2 Entering Surface Element Data

The user must enter eight pieces of data for each set of surface element data.

I) Element type (2 - triangular, 3 - quadrilateral)

A) Material property orientation angle
B1) Membrane thickness at connection points* point 1
B2) " " point 2
B3) " " point 3
B4) " " point 4
C) Default value for the membrane thickness
D) Nonstructural mass per unit area

* Optional for NASTRAN

The maximum number of surface element sets is one thousand.

FILE FORMAT

N N = Number of sets
$I_1, A_1, B1_1, \ldots B4_1, C_1, D_1$
$I_2, A_2, B1_2, \ldots B4_2, C_2, D_2$
.
.
.
$I_N, A_N, B1_N, \ldots B4_N, C_N, D_N$

6.3.1.3 Entering Axisymmetric Element Data

The user must enter three pieces of data for each set of axisymmetric element data.

I) Element type (5 - constant strain triangular ring, 6 - trapezoidal ring)

J) Material identification number

A) Material property orientation angle

The maximum number of axisymmetric element sets is fifty.

FILE FORMAT

N N = Number of sets

I_1, J_1, A_1
I_2, J_2, A_2
.
.
.
I_N, J_N, A_N

6.3.1.4 Entering Element Property Pointers

If the user wants to enter each element and its property pointer separately, the user must enter two pieces of data for each pointer.

I) Element number
J) Element property pointer

The maximum number of element property pointers is five thousand.

FILE FORMAT

N N = Number of sets
I_1, J_1
I_2, J_2
.
.
.
I_N, J_N

If the user wants to enter a range of elements for each property pointer, the user must enter three pieces of data for each pointer.

I) Beginning element number
J) Ending element number
K) Element property pointer

The maximum number of element property pointers is five thousand.

FILE FORMAT

N N = Number of sets
I_1, J_1, K_1
I_2, J_2, K_2
.
.
.
I_N, J_N, K_N

6.3.2 Entering Material Property Data

6.3.2.1 Entering Isotropic Material Properties

The user must enter seven pieces of data for each set of isotropic material property data.

A) Young's modulus*
B) Shear modulus*
C) Poisson's ratio*
D) Mass density
E) Thermal expansion coefficient
F) Thermal expansion reference temperature
G) Structural element damping coefficient

* Optional for NASTRAN, but A or B must be specified

The maximum number of material property sets is fifty.

FILE FORMAT

N $\qquad$ N = Number of sets

$A_1, B_1, C_1, \ldots, G_1$
$A_2, B_2, C_2, \ldots, G_2$
.
.
.
$A_N, B_N, C_N, \ldots, G_N$

6.3.2.2 Entering Orthotropic Material Properties

The user must enter thirteen pieces of data for each set of orthotropic material property data.

A1) Young's moduli (x direction)
A2) (o direction)
A3) (z direction)
B) Shear modulus
C1) Poisson's ratios (coupled strain ratio in the xo direction)
C2) (zo direction)
C3) (zx direction)
D) Mass density
E1) Thermal expansion coefficients (x)
E2) (o)
E3) (z)
F) Thermal expansion reference temperature
G) Structural element damping coefficient

The maximum number of material property sets is fifty.

FILE FORMAT

N N = Number of sets
$A1_1, A2_1, \ldots, G_1$

.
.
.

$A1_N, A2_N, \ldots, G_N$

6.3.2.3 Entering Table References For Temperature-Dependent References

The user must enter seventeen pieces of data for each set of table references.

I) Material type (2 - isotropic material)
(4 - orthotropic material)
J) Material property identification number
K1) References to table identification numbers
K2) " " "
.
.
.
K15) " " "

The maximum number of sets of table references is fifty.

FILE FORMAT

N N = Number of sets

$I_1, J_1, K1_1, \ldots, K15_1$
$I_2, J_2, K1_2, \ldots, K15_2$
.
.
.
$I_N, J_N, K1_N, \ldots, K15_N$

6.3.2.4 Entering Tabular Functions For Generating Temperature-Dependent Material Properties

The user must enter two pieces of integer data plus the tabular entries for each function.

I) Table type*
J) Number of tabular entries

X_1, Y_1) Tabular entries

.
.
.

X_J, Y_J) " "

* (1 is the only value currently supported for NASTRAN interface)

The maximum number of functions is fifty.

FILE FORMAT

N N = Number of functions

I_1, J_1
X_{11}, Y_{11}
X_{21}, Y_{21}
.
.
.
$X_{J_1 1}, Y_{J_1 1}$
I_2, J_2
X_{12}, Y_{12}
X_{22}, Y_{22}
.
.
.
$X_{J_2 2}, Y_{J_2 2}$
I_N, J_N
X_{1N}, Y_{1N}
X_{2N}, Y_{2N}
.
.
.
$X_{J_N N}, Y_{J_N N}$

6.3.2.5 Entering Nodal Temperatures

If the user wants to enter one node per temperature, the user must enter two pieces of data for each temperature.

I) Node number

A) Temperature

The maximum number of nodal temperatures is nine thousand.

FILE FORMAT

N N = Number of temperatures

I_1, A_1
I_2, A_2
.
.
.
I_N, A_N

If the user wants to enter several nodes per temperature, the user must enter three pieces of data for each temperature.

I) Beginning node number
J) Ending node number

A) Temperature

The maximum number of nodal temperatures is nine thousand.

FILE FORMAT

N N = Number of temperatures

I_1, J_1, A_1
I_2, J_2, A_2
.
.
.
I_N, J_N, A_N

6.3.3 Entering Constraint Data

6.3.3.1 Entering Single Point Constraints

The user must enter three pieces of data for each set of single point constraint data:

I) Node number
J) Component number

A) Enforced displacement

The maximum number of single point constraint sets is nine thousand.

FILE FORMAT

N N = Number of sets
I_1, J_1, A_1
I_2, J_2, A_2
.
.
.
I_N, J_N, A_N

6.3.3.2 Entering Multipoint Constraints

The user must enter the number of nodes and the node numbers, component numbers, and coefficients for each set of multiple point constraint data.

I)	Number of nodes	$1<=I<=12$
J_{1-I})	Node number	
K_{1-I})	Component number	
A_{1-I})	Coefficient	

The maximum number of multiple point constraint sets is two hundred.

FILE FORMAT

N N = Number of sets

I_1

J_{11}, K_{11}, A_{11}

J_{21}, K_{21}, A_{21}

.

.

.

$J_{I_1 1}, K_{I_1 1}, A_{I_1 1}$

I_2

J_{12}, K_{12}, A_{12}

J_{22}, K_{22}, A_{22}

.

.

.

$J_{I_2 2}, K_{I_2 2}, A_{I_2 2}$

I_N

J_{1N}, K_{1N}, A_{1N}

J_{2N}, K_{2N}, A_{2N}

.

.

.

$J_{I_N N}, K_{I_N N}, A_{I_N N}$

6.3.4 Entering Loading Data

6.3.4.1 Entering Concentrated Load At Node

The user must enter six pieces of data for each set of load data at node.

I) Node number
J) Coordinate system identification number*

A) Scale factor
B1) Components of vector measured in coordinate system defined by J
B2)
B3)

*Optional for NASTRAN

The maximum number of load sets is five hundred.

FILE FORMAT

N N = Number of sets
$I_1, J_1, A_1, B1_1, B2_1, B3_1$
$I_2, J_2, A_2, B1_2, B2_2, B3_2$
.
.
.
$I_N, J_N, A_N, B1_N, B2_N, B3_N$

6.3.4.2 Entering Moment At Node

The user must enter six pieces of data for each set of moment data at node.

I) Node number
J) Coordinate system identification number

A) Scale factor
B1) Components of vector measured in coordinate system defined by J
B2)
B3)

The maximum number of load sets is five hundred.

FILE FORMAT

N N = Number of sets

$I_1, J_1, A_1, B1_1, B2_1, B3_1$
$I_2, J_2, A_2, B1_2, B2_2, B3_2$
.
.
.
$I_N, J_N, A_N, B1_N, B2_N, B3_N$

6.3.4.3 Entering Pressure on Face of Element

For each set of pressure data, the user has the choice of naming one element or more than one element. If the user wants to name more than one element, he must enter six pieces of data for each set.

I) Beginning element number
J) Ending element number

A1) Pressure at corner of face
A2) "
A3) "
A4) "

The maximum number of load sets is five hundred.

FILE FORMAT

N — N = Number of sets
M_1 — M = Indicates number of elements named*
$I_1, J_1, A1_1, A2_1, A3_1, A4_1$
M_2
$I_2, J_2, A1_2, A2_2, A3_2, A4_2$
.
.
.
M_N
$I_N, J_N, A1_N, A2_N, A3_N, A4_N$

*M = 1 more than one element named

If the user wants to name only one element per set, the user must enter seven pieces of data for each set.

I) Element number
J1) Node number of corner of face*
J2) Node number of corner opposite to J1*
(must be blank for triangular surface)

A1) Pressure at corner of face
A2) "
A3) "
A4) "

*Required data for solid elements only
*Enter -1 for blank node numbers

The maximum number of load sets is five hundred.

FILE FORMAT

N	N = Number of sets
M_1	M = Indicates number of elements named*
$I_1, J1_1, J2_1, A1_1, \ldots, A4_1$	
M_2	
$I_2, J1_2, J2_2, A1_2, \ldots, A4_2$	
.	
.	
.	
M_N	
$I_N, J1_N, J2_N, A1_N, \ldots, A4_N$	

*M = 0 only one element named

6.4 Change Finalized Data

The user can add to or change previously entered finalized data.

ESMOSS keeps a counter for each of the different types of finalized data so that the user can add more finalized data later that session or in a subsequent session if he desires. Additional finalized data is entered the same way as regular finalized data.

Every record of finalized data has an active flag associated with it. If the active flag is on, ESMOSS will process the record of data. If the active flag is off, ESMOSS will ignore the record of data.. The user can change previously entered data by turning off this active flag for the affected records and then entering the replacement data. In the special cases of element property pointers and nodal temperatures, there are no active flags. Instead, the user can delete an entry or delete all of the entries or directly change the value of an entry. You may only change finalized data at the terminal, not from a file.

The Change Finalized Data menu is:

```
CHANGE FINALIZED DATA

  1 TURN FLAGS OFF                    3 NODAL TEMPERATURES
  2 ELEMENT PROPERTY POINTERS
```

These menu items are discussed in detail in the following sections.

6.4.1 Turning Active Flags Off

```
TURN ACTIVE FLAGS OFF

  1 SOLID ELEMENT DATA                6 TABULAR FUNCTION DATA
  2 SURFACE ELEMENT DATA              7 SINGLE POINT CONSTRAINT
  3 AXISYMMETRIC ELEMENT DATA         8 MULTIPLE POINT CONSTRAINT
  4 MATERIAL PROPERTIES               9 LOADING DATA
  5 MATERIAL TEMPERATURE REFERENCES
```

The user must answer the following questions for each type of finalized data in which he wishes to turn off some or all of the active flags.

1) Do you want to turn off all the flags?
   If no:
2) How many flags do you want to turn off? (must be between 1 and 100)

3) Enter the identification numbers of the flags to turn off.

6.4.2 Changing Element Property Pointers

The user must answer the following questions.

1) Do you want to delete all of the property pointers?
   If no:
2) Enter the element number, or enter 0 to stop.
3) Enter 1 to change the pointer, or 2 to delete the pointer.
   If change pointer:
4) Enter the new property pointer.

6.4.3 Changing Nodal Temperatures

The user must answer the following questions.

1) Do you want to delete all of the nodal temperatures?
   If no:
2) Enter the node number, or enter 0 to stop.
3) Enter 1 to change the temperature, or 2 to delete the temperature.
   If change temperature:
4) Enter the new temperature.

6.5 End

End must be executed to get out of the Finalize Discrete Model module.

ESMOSS asks for the name of a discrete file, giving the user the option to default to the discrete file entered in Define Discrete File. ESMOSS then asks if the user wants to save his finalized data. If yes, the finalized data will be saved on the discrete file. If no, the discrete file will not change, and any new finalized data is lost.

7.0 GENERATE NASTRAN INPUT

7.1 Introduction

The Generate NASTRAN Input module of ESMOSS produces a sequential file of data which can be used as an input deck to NASTRAN. This module produces the bulk data deck for NASTRAN, using the data on the discrete file specified by the user. In addition, ESMOSS allows the user to enter card image records to the file before and after the bulk data deck either manually or from a file. In this way the user can enter the Executive Control Deck and the Case Control Deck via ESMOSS if so desired. The sequential file may also be edited by the user after running ESMOSS and prior to submission to NASTRAN.

The menu sequence to generate NASTRAN input is.

MASTER MENU

1 EXECUTE COMMAND FILE
2 UTILITY COMMANDS
3 GEOMETRY MODEL CONSTRUCTION
4 DISCRETE MODEL CONSTRUCTION
5 RECIPE ENGINE PARTS
* 6 GENERATE ANALYSIS INPUT
7 FILE HANDLER
8 DONE

GENERATE ANALYSIS INPUT

1 NASTRAN

7.2 Running the NASTRAN Input Generator

7.2.1 Entering Required File Names

ESMOSS asks for two files. a discrete file and the NASTRAN input file. For the discrete file, enter the fully qualified name of the file that contains the discrete model data to use to generate the NASTRAN bulk data deck. For the NASTRAN input file, enter the fully qualified name of the file where you want this module to write the NASTRAN input deck.

7.2.2 Entering Additional Data Before The Bulk Data Deck

ESMOSS allows the user to enter card image data records to the NASTRAN input file before and after ESMOSS generates the bulk data deck.

After the user enters the required file names, ESMOSS asks the user if he wishes to enter any data to the NASTRAN input file before the bulk data deck. If no, skip the rest of this section.

If yes, ESMOSS asks if the data is on a file. If it's not, ESMOSS asks the user to enter the number of card images and then to enter the card images. When entering the card images manually, it's not necessary to blank fill the card after the data, a carriage return will do this.

If the data is on a file, ESMOSS asks for the file name. The file must follow the following format.

```
N                    N = Number of card images
Card Image 1
     .
     .
     .
Card Image N
```

Each card image is read with a format of eighty characters.

7.2.3 Generating The Bulk Data Deck

After the user has the chance to enter data before the bulk data deck, ESMOSS automatically generates the bulk data deck based on the information on the user's discrete file. If there is any needed information not available on the discrete file, ESMOSS will ask the user for it. Whenever available, ESMOSS allows the user to use default values, but the user always has the opportunity to override the defaults.

The user can enter the data via a file or manually. If the data is on a file, the user will be asked for a finalization data file name. If additional data is needed later in the generation of the bulk data deck, it can reside on the same finalization data file used previously in the session, or the data can reside on a different finalization data file, or it can be input manually.

7.2.3.1 Additional Data Needed For The Bulk Data Deck

When the user wants to enter non-default data for an item on one card or several cards, he must answer the following questions.

HOW MANY WILL NOT USE THE DEFAULT? >>
ARE YOU CHANGING THE DEFAULTS ON ALL OF THE CARDS? >>
If yes:
TO THE SAME VALUE? >>
If yes.
ENTER THE VALUE >>
If not the same value:
ARE THE VALUES ON A FILE? >>
If yes:
ENTER FILE NAME >>
The values from the file will now be read.
If no:
ENTER THE VALUES IN ORDER >>

If not changing the defaults on all of the cards:
IS THE NON-DEFAULT DATA ON A FILE? >>
If yes:
ENTER FILE NAME >>
The id's and the values from the file will now be read.
If no:
ENTER THE ID'S THAT DO NOT USE THE DEFAULT >>
ENTER THE VALUES IN ORDER >>

The file format is free format. The user can put as many or as few values on any line as he wants, using a maximum of eighty characters per line. If the defaults for an item on all of the cards are changing, the file should contain only the values. If only selected cards are changing, the file should contain the id of the card, followed by the value, the id of the card, followed by the value, etc.

7.2.3.1.1 NASTRAN Cards That Require Additional Data

7.2.3.1.1.1 MAT1 Card

The user can input the material coordinate system identification number or use the default which is the basic coordinate system.

7.2.3.1.1.2 TEMP Card

There are no set numbers associated with the temperatures on the discrete file. ESMOSS asks the user if he wants to begin numbering the TEMP cards with 1 or with some other number.

7.2.3.1.1.3 PSHELL Card

Many of the items on the PSHELL card need to be input by the user. These items do all have standard defaults that can be used. They are.

1) Material identification number for membrane
   Default is no membrane or coupling stiffness

2) Material identification number for bending
   Default is no bending, coupling, or transverse shear stiffness

3) Bending stiffness parameter
   Default is 1.0

4) Material identification number for transverse shear
   Default is no transverse shear flexibility

5) Transverse shear thickness divided by membrane thickness
   Default is .833333

6,7) Fiber distances for stress computation
   Default is -1/2 * membrane thickness default
   and 1/2 * membrane thickness default

8) Material identification number for membrane-bending coupling
   Default is no bending-membrane coupling

7.2.3.1.1.4 PSOLID Card

Several of the items on the PSOLID card need to be input by the user. They all have standard defaults that can be used. They are.

1) Identification number of material coordinate system
   Default is -1, which is the element coordinate system.

2) Integration network
   Default is 2, which is 8 point for HEXA and 6 point for PENTA

3) Location selection for stress output
   Default is 0, which is center point and vertex locations

7.2.4 Entering Additional Data After The Bulk Data Deck

After the bulk data deck has been generated ESMOSS prints a message, "Automatic generation of the bulk data deck is complete." Then the user is asked if he wishes to enter additional data to the end of the deck. If yes, ESMOSS asks the user for the data the same way as entering data before the bulk data deck. See section 7.2.2.

APPENDIX A - ESMOSS Menu File

```
1,8
MASTER MENU
EXECUTE COMMAND FILE
3,1,1,2,1
ISSUE ESMOSS COMMANDS AND DATA FROM A FILE
(THE COMMAND FILE IS A SEQUENTIAL TEXT FILE)
1,1
— ESMOSS COMMAND FILE REQUIRED —
UTILITY COMMANDS
1,1,2,8,0
ESMOSS UTILITY COMMANDS:
      UTILITY COMMANDS
      MENU REDISPLAY
      HELP **
      CHANGE SESSION PARAMETERS
      PLOT MODEL
      CHANGE PLOT PARAMETERS
      DONE
GEOMETRY MODEL CONSTRUCTION
1,1,4,6,0
CONSTRUCT A GEOMETRIC MODEL WITH:
      POINTS
      CURVES
      SURFACES
      REGIONS
      INTERFACE 2 GEOMETRIC MODELS
DISCRETE MODEL CONSTRUCTION
1,1,20,5,0
DISCRETIZATION OPTIONS:
      DISCRETIZE GEOMETRIC MODEL
      DISCRETE MODEL PLOT
      INTERFACE DISCRETE MODELS
      FINALIZE DISCRETE MODEL
RECIPE ENGINE PARTS
5,4,100,8,2
BUILD THE GEOMETRY AND DISCRETIZE AN ENGINE
PART FROM A PRE-PACKAGED SET OF INSTRUCTIONS
RECIPES EXIST FOR THE FOLLOWING ENGINE PARTS:
      1.  DOVETAIL-PLATFORM
      2.  BICONVEX AIRFOIL
      3.  BURNER LINER
      4.  BROACH
      5.  DISC
12,1
— RECIPE FILE REQUIRED —
8,2
— RECIPE OUTPUT COMMAND FILE REQUIRED —
```

```
GENERATE ANALYSIS INPUT
1,1,31,1,0
NASTRAN INPUT IS CURRENTLY THE ONLY TYPE SUPPORTED
FILE HANDLER
00075020
1,1,32,0,0
00075030
DONE
00240804
6,0,0,1,0
00240904
TERMINATE ESMOSS SESSION
00241004
2,7
UTILITY COMMAND MENU
UTILITY COMMANDS
1,1,2,0,0
MENU REDISPLAY
3,10,-1,1,0
REDISPLAY CURRENT MENU
HELP **
2,1,0,5,0
SHOW HELP MESSAGES
    'HELP'    - SHOW HELP MESSAGES FOR ALL
                COMMANDS IN THE CURRENT MENU
    'HELP N'  - SHOW HELP MESSAGES FOR COMMAND
                NUMBER N OF THE CURRENT MENU
CHANGE SESSION PARAMETERS
1,1,3,0,0
PLOT MODEL
5,3,100,0,0
CHANGE PLOT PARAMETERS
1,1,12,0,0
DONE
6,0,0,1,0
TERMINATE ESMOSS SESSION
3,8
CHANGE SESSION PARAMETERS MENU
EXECUTE COMMAND FILE
3,1,1,2,1
ISSUE ESMOSS COMMANDS AND DATA FROM A FILE
(THE COMMAND FILE IS A SEQUENTIAL TEXT FILE)
1,1
-- ESMOSS COMMAND FILE REQUIRED --
TERMINATE COMMAND FILE
3,1,-1,0,0
ECHO FILE ON
3,3,1,2,1
WRITE ESMOSS COMMANDS AND INPUT
DATA TO A SEQUENTIAL TEXT FILE
2,2
-- ECHO FILE REQUIRED --
ECHO FILE OFF
```

```
3,3,-1,0,0
DISPLAY MENUS
3,2,1,0,0
SUPPRESS MENUS
3,2,-1,0,0
DISPLAY PROMPTS
3,5,1,0,0
SUPPRESS PROMPTS
3,5,-1,0,0
4,7
GEOMETRY MODEL CONSTRUCTION MENU
DEFINE GEOMETRY FILE
5,1,0,2,1
SPECIFY A SEQUENTIAL FILE THAT
CONTAINS AN ESMOSS GEOMETRY MODEL
3,3
— GEOMETRY FILE REQUIRED —
POINT
1,1,5,8,0
DEVELOP GEOMETRY WITH POINTS:
      BASIC DEFINITION (X,Y,Z)
      POINT FILE
      PARAMETRIC CURVE
      PARAMETRIC SURFACE
      TWO CURVE INTERSECTION
      DELETE
      RENAME (NOT IMPLEMENTED)
CURVE
1,1,6,11,0
DEVELOP GEOMETRY WITH CURVES:
      LINES
      CIRCLES
      CIRCULAR ARCS
      TWO SURFACE INTERSECTION
      POINT FILE
      FIT POINT SEQUENCE
      MERGE TWO CURVES
      PARABOLIC ARC
      DELETE
      RENAME (NOT IMPLEMENTED)
SURFACE
1,1,7,12,0
DEVELOP GEOMTETRY WITH SURFACES:
      COORDINATE PLANE
      FOUR POINT PLANE
      CIRCULAR CYLINDER
      FRUSIRUM
      RULED SURFACE
      CUBIC BSURFACE
      SUBSURFACE PATCH
      POINT FILE
      SURFACE OF REVOLUTION
      DELETE
```

RENAME (NOT IMPLEMENTED)
REGIONS
1,1,8,3,0
DEVELOP GEOMETRY REGIONS (FOR A RELATIONAL MODEL)
REGION
DELETE
INTERFACE GEOMETRIC MODELS
5,1,9,2,2
DEFINE 2 ND MODEL FILE
DEFINE OUTPUT FILE
-3,1
— 2 ND GEOMETRY FILE REQUIRED —
-3,2
— DEFINE GEOMETRY OUTPUT FILE —
END
7,1,1,1,0
CLOSE GEOMETRY FILE AND EXIT MENU
5,6
POINT MENU
BASIC DEFINITION (X,Y,Z)
5,1,101,2,0
DEFINE A POINT USING AN X-COORDINATE,
A Y-COORDINATE AND A Z-COORDINATE
POINT FILE
5,1,102,1,1
DEFINE A POINT FROM A FILE OF POINTS
1,1
— POINT FILE REQUIRED —
PARAMETRIC CURVE
5,1,103,1,0
DEFINE A POINT ALONG A CURVE
PARAMETRIC SURFACE
5,1,104,1,0
DEFINE A POINT ALONG A SURFACE
TWO CURVE INTERSECTION
5,1,105,1,0
DEFINE A POINT AS THE INTERSECTION OF TWO CURVES
DELETE
5,1,106,1,0
DELETE A POINT
6,9
CURVE MENU
LINE
5,1,201,1,0
DEFINE A CURVE AS A LINE
CIRCLE
5,1,202,1,0
DEFINE A CURVE AS A CIRCLE
CIRCULAR ARC
5,1,203,1,0
DEFINE A CURVE AS A CIRCULAR ARC
TWO SURFACE INTERSECTION
5,1,204,1,0

DEFINE A CURVE AS THE INTERSECTION OF TWO SURFACES
POINT FILE
5.1.205.1.1
DEFINE A CURVE FROM A FILE OF POINTS
1.1
-- POINT FILE REQUIRED --
FIT POINT SEQUENCE
5.1.206.2.0
DEFINE A CURVE BY FITTING THE CURVE ALONG
A SEQUENCE OF POINTS
MERGE TWO CURVES
5.1.207.1.0
DEFINE A CURVE BY JOINING TWO OTHER CURVES
PARABOLIC ARC
5.1.208.1.0
DEFINE A CURVE AS A PARABOLIC ARC
DELETE
5.1.209.1.0
DELETE A CURVE
7.10
SURFACE MENU
COORDINATE PLANE
5.1.301.1.0
DEFINE A SURFACE AS A COORDINATE PLANE
FOUR POINT PLANE
5.1.302.1.0
DEFINE A SURFACE AS A FOUR POINT PLANE (OR WARPED SURFACE)
CIRCULAR CYLINDER
5.1.303.1.0
DEFINE A SURFACE AS A CIRCULAR CYLINDER
FRUSTRUM
5.1.304.1.0
DEFINE A SURFACE AS A FRUSTRUM
RULED SURFACE
5.1.305.1.0
DEFINE A SURFACE AS A RULED SURFACE
CUBIC BSURFACE
5.1.306.1.0
DEFINE A SURFACE AS A CUBIC BSURFACE
SUBSURFACE PATCH
5.1.307.1.0
DEFINE A SURFACE USING A SUBSURFACE PATCH
POINT FILE
5.1.308.1.1
DEFINE A SURFACE FROM A FILE OF POINTS
1.1
-- POINT FILE REQUIRED --
SURFACE OF REVOLUTION
5.1.309.1.0
DEFINE A SURFACE OF REVOLUTION
DELETE
5.1.310.1.0
DELETE A SURFACE

8.4
REGION MENU
THREE-D SIX SIDED
5.1.401.0.0
TWO-D THREE SIDED
5,1,402,0,0
TWO-D FOUR SIDED
5,1,403,0,0
DELETE
5,1,404,1,0
DELETE A REGION
12,10
CHANGE PLOT PARAMETERS MENU
PLOT MODEL
5,3,100,0,0
DEFAULT VALUES
5,3,200,0,0
DISPLAY MODE
5,3,301,0,0
INTENSITY
5,3,302,0,0
TITLE
5,3,305,0,0
ROTATE
1,1,13,0,0
COLOR
1,1,14,0,0
WINDOW
1,1,15,0,0
LABEL
1,1,16,0,0
VISIBILITY RANGE
1,1,17,0,0
13,4
ROTATION MENU
RESET ROTATIONS (X=Y=Z=0)
5,3,401,0,0
SET AXIS ROTATIONS
5,3,403,0,0
INCREMENT AXIS ROTATIONS
5,3,404,0,0
SHOW CURRENT ROTATION
5,3,405,0,0
14,7
COLOR MENU
BLACK
5,3,421,0,0
RED
5,3,422,0,0
BLUE
5,3,423,0,0
GREEN
5,3,424,0,0

YELLOW
5,3,425,0,0
MAGENTA
5,3,426,0,0
CYAN
5,3,427,0,0
15,3
WINDOWING MENU
AUTO SCALE
5,3,441,0,0
SET WINDOW MIN-MAX
5,3,442,0,0
SHOW CURRENT WINDOWING
5,3,443,0,0
16,9
LABELLING MENU
PT-CRV-SURF ON
5,3,461,0,0
REGION ON
5,3,462,0,0
NODE ON
5,3,463,0,0
ELEMENT ON
5,3,464,0,0
PT-CRV-SURF OFF
5,3,465,0,0
REGION OFF
5,3,466,0,0
NODE OFF
5,3,467,0,0
ELEMENT OFF
5,3,468,0,0
ALL OFF
5,3,469,0,0
17,5
VISIBILITY MENU
ALL ON
5,3,481,0,0
ALL GEOMETRY OFF
5,3,482,0,0
ALL DISCRETIZED OFF
5,3,483,0,0
CHANGE GEOMETRY
1,1,18,0,0
CHANGE DISCRETIZED
1,1,19,0,0
18,8
CHANGE GEOMETRY VISIBILITY MENU
POINTS ON
5,3,484,0,0
POINTS OFF
5,3,485,0,0
CURVES ON

```
5,3,486,0,0
CURVES OFF
5,3,487,0,0
SURFACES ON
5,3,488,0,0
SURFACES OFF
5,3,489,0,0
REGIONS ON
5,3,490,0,0
REGIONS OFF
5,3,491,0,0
19,4
CHANGE DISCRETIZED VISIBILITY MENU
NODES ON
5,3,492,0,0
NODES OFF
5,3,493,0,0
ELEMENTS ON
5,3,494,0,0
ELEMENTS OFF
5,3,495,0,0
20,4
DEVELOP DISCRETE MODEL
DISCRETIZE GEOMETRIC MODEL
1,1,21,2,0
GENERATES A FINITE ELEMENT MODEL FROM
A REGIONALIZED GEOMETRIC MODEL
DISCRETE MODEL PLOT
5,2,4000,1,1
PLOTS AN EXISTING DISCRETE MODEL
4,1
-- DISCRETE FILE REQUIRED --
INTERFACE DISCRETE MODELS
1,1,33,1,0
MERGE 2 DISCRETE MODEL FILES
FINALIZE DISCRETE MODEL
1,1,23,5,0
ADD OR CHANGE ELEMENT PROPERTY DATA
              MATERIAL PROPERTY DATA
              CONSTRAINT DATA
              LOADING DATA
TO DISCRETE MODEL.
21,5
DISCRETIZE GEOMETRIC MODEL
DEFINE DISCRETIZING FILES
5,2,1100,4,2
THIS COMMAND MUST BE EXECUTED FIRST
TWO FILES ARE DEFINED.
     GEOMETRY FILE
     DISCRETE MODEL FILE
3,1
-- GEOMETRY FILE REQUIRED --
4,3
```

```
-- DISCRETE FILE REQUIRED --
DISPLAY MODEL STATUS
5,2,1200,2,0
DISPLAYS THE DISCRETIZATION STATUS OF
EACH REGION OF THE GEOMETRIC MODEL
DISCRETIZE REGION
1,1,22,4,0
DISCRETIZATION LIBRARY PROCEDURES:
     EIGHT NODED BRICKS
     REGULAR TWO DIMENSIONAL REGION
     IRREGULAR TWO DIMENSIONAL REGION
REGIONALIZED MODEL PLOT
5,2,1500,3,0
PLOTS THE MODEL SHOWING NODES AND
ELEMENTS FOR DISCRETIZED REGIONS AND
EDGES FOR UNDISCRETIZED REGIONS
END
7,2,1300,1,0
CLOSE DISCRETE FILE AND EXIT MENU
22,3
DISCRETIZE REGION
EIGHT NODED BRICKS
5,2,1401,2,0
DISCRETIZE A THREE DIMENSIONAL REGION
WITH EIGHT NODED BRICK ELEMENTS
REGULAR 2-D REGION
5,2,1451,3,0
DISCRETIZE A TWO DIMENSIONAL REGION
WITH OPPOSITE EDGES HAVING AN EQUAL
NUMBER OF NODES
IRREGULAR 2-D REGION
5,2,1452,3,0
DISCRETIZE A TWO DIMENSIONAL REGION
WITH OPPOSITE EDGES HAVING AN UNEQUAL
NUMBER OF NODES
23,4
FINALIZE DISCRETE MODEL
DEFINE DISCRETE FILE
5,2,7600,1,1
THIS COMMAND MUST BE EXECUTED FIRST
4,3
-- DISCRETE FILE REQUIRED --
ADD FINALIZED DATA
1,1,24,4,0
ADD ELEMENT PROPERTY DATA
     MATERIAL PROPERTY DATA
     CONSTRAINT DATA
     LOADING DATA
CHANGE FINALIZED DATA
1,1,29,3,0
THE USER CAN 1) TURN ACTIVE FLAGS OFF
             2) CHANGE ELEMENT PROPERTY POINTERS
             3) CHANGE NODAL TEMPERATURES
```

```
END
7.2.7700.1.1
WRAP UP FINALIZATION AND EXIT MENU
4.3
-- DISCRETE FILE REQUIRED --
24.4
ADD FINALIZED DATA
ELEMENT PROPERTY DATA
1.1,25.4.0
SOLID ELEMENT DATA
SURFACE ELEMENT DATA
AXISYMETTRIC ELEMENT DATA
ELEMENT PROPERTY POINTERS
MATERIAL PROPERTY DATA
1.1.26.1.0
MATERIAL PROPERTIES AND TEMPERATURE DATA
CONSTRAINT DATA
1.1.27.1.0
SINGLE POINT AND MULTI POINT
LOADING DATA
1.1.28.3.0
LOAD AT NODE
MOMENT AT NODE
PRESSURE ON FACE
25.8
ADD ELEMENT PROPERTY DATA
SOLID FROM FILE
5.2.7111.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
SOLID FROM TERMINAL
5.2.7112.0.0
SURFACE FROM FILE
5.2.7121.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
SURFACE FROM TERMINAL
5.2.7122.0.0
AXISYMMETRIC FROM FILE
5.2.7131.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
AXISYMMETRIC FROM TERMINAL
5.2.7132.0.0
PROPERTY POINTERS FILE
5.2.7141.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
PROPERTY POINTERS TERMINAL
5.2.7142.0.0
26.10
ADD MATERIAL PROPERTY DATA
ISOTROPIC MATERIAL FILE
```

5.2.7211.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
ISOTROPIC MATERIAL TERMINAL
5.2.7212.0.0
ORTHOTROPIC MATERIAL FILE
5.2.7213.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
ORTHOTROPIC MATERIAL TERMINAL
5.2.7214.0.0
TEMPERATURE REFERENCES FILE
5.2.7221.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
TEMPERATURE REFERENCES TERMINAL
5.2.7222.0.0
TABULAR FUNCTION FILE
5.2.7223.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
TABULAR FUNCTION TERMINAL
5.2.7224.0.0
NODAL TEMPERATURES FILE
5.2.7231.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
NODAL TEMPERATURES TERMINAL
5.2.7232.0.0
27.4
ADD CONSTRAINT DATA
SINGLE POINT FILE
5.2.7311.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
SINGLE POINT TERMINAL
5.2.7312.0.0
MULTIPLE POINT FILE
5.2.7321.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
MULTIPLE POINT TERMINAL
5.2.7322.0.0
28.6
ADD LOADING DATA
LOAD AT NODE-FILE
5.2.7411.0.1
13.1
-- FINALIZATION DATA FILE REQUIRED --
LOAD AT NODE-TERM
5.2.7412.0.0
MOMENT AT NODE-FILE
5.2.7421.0.1

13.1
-- FINALIZATION DATA FILE REQUIRED --
MOMENT AT NODE-TERM
5.2.7422.0.0
PRESSURE ON FACE-FILE
5,2,7431.0,1
13.1
-- FINALIZATION DATA FILE REQUIRED --
PRESSURE ON FACE-TERM
5.2.7432.0.0
29.3
CHANGE FINALIZED DATA
TURN FLAGS OFF
1.1.30.6.0
ELEMENT PROPERTY DATA
MATERIAL PROPERTIES
MATERIAL TEMPERATURE DEPENDENT REFERENCE DATA
TABULAR FUNCTION DATA
CONSTRAINT DATA
LOADING DATA
ELEMENT PROPERTY POINTERS
5.2.7504.0.0
NODAL TEMPERATURES
5.2.7508.0.0
30.9
TURN ACTIVE FLAGS OFF
SOLID ELEMENT DATA
5.2.7501.0.0
SURFACE ELEMENT DATA
5.2.7502.0.0
AXISYMMETRIC ELEMENT DATA
5.2.7503.0.0
MATERIAL PROPERTIES
5.2.7505.0.0
MATERIAL TEMPERATURE REFERENCES
5.2.7506.0.0
TABULAR FUNCTION DATA
5.2.7507.0.0
SINGLE POINT CONSTRAINT
5.2.7509.0.0
MULTIPLE POINT CONSTRAINT
5.2.7510.0.0
LOADING DATA
5.2.7511.0.0
31.1
GENERATE ANALYSIS INPUT
NASTRAN
5.5.100.1.2
GENERATE THE INPUT DECK FOR NASTRAN
4.1
-- DISCRETE FILE REQUIRED --
11.3
-- NASTRAN INPUT FILE REQUIRED --

32,6
00239107
FILE HANDLER MENU
00239108
DIRECTORY DISPLAY
00239109
4,1,1,0,0
00239110
ADD DIRECTORY ENTRY
00239111
4,1,2,1,0
00239112
ADD A FILE ENTRY TO THE FILE DIRECTORY
00239113
DELETE DIRECTORY ENTRY
00239114
4,1,3,1,0
00239115
DELETE A FILE ENTRY FROM THE FILE DIRECTORY
00239116
DISPLAY LUT
00239117
4,0,1,1,0
00239118
DISPLAY LOGICAL UNIT TABLE
00239119
OPEN FILE
00239120
4,0,2,0,0
00239121
CLOSE FILE
00239130
4,0,3,0,0
00239140
33,4
INTERFACE DISCRETE MODELS
DEFINE MODEL FILES
5,2,6100,2,2
DEFINE 1 ST FILE
DEFINE 2 ND FILE
4,3
— DISCRETE FILE REQUIRED —
-4,3
— 2ND DISCRETE FILE REQUIRED —
MOVE NODES
5,2,6200,1,0
CHANGE NODE COORDINATES
ELIMINATE COMMON NODES
5,2,6300,1,0
ELIMINATE DUPLICATE NODES
END
7,2,6400,2,1
WRITE OUTPUT FILE

DEFINE OUTPUT FILE
-4.3
-- DEFINE DISCRETE OUTPUT FILE --

APPENDIX B - ESMOSS RECIPES

Burner Liner Nugget

Disk

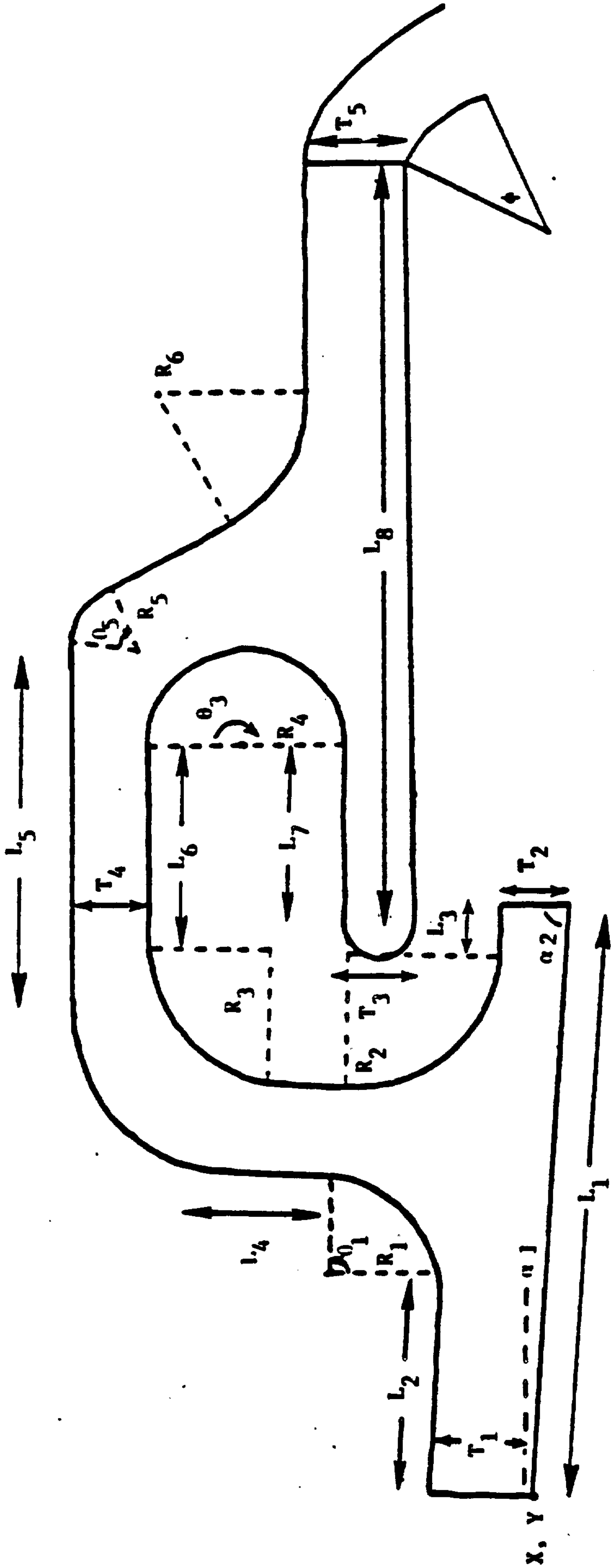
Broach

Airfoil

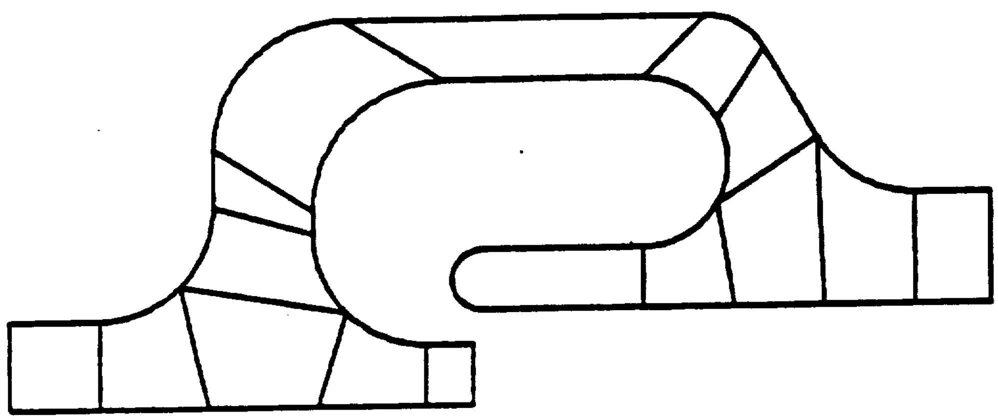
Dovetail-Platform

Air-Cooled Turbine Blade

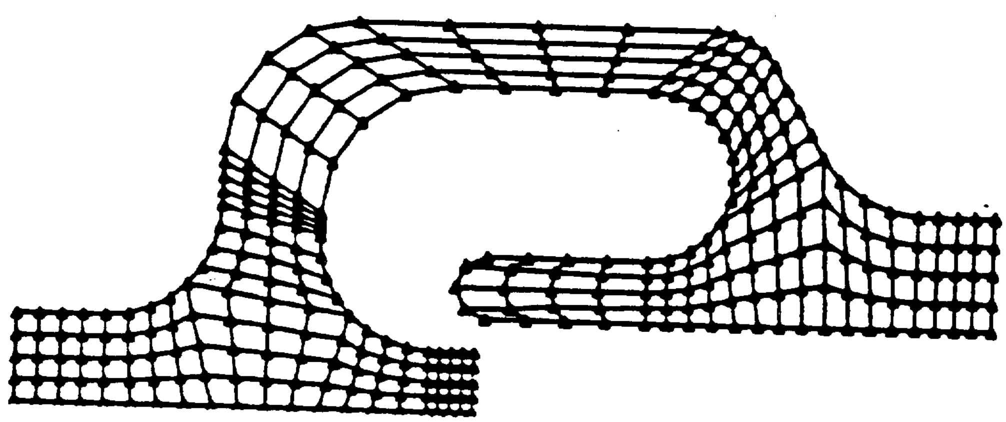
Burner Liner Nugget - Parametric Model



Burner Liner Nugget - Geometric Model



Burner Liner Nugget - Discrete Model



```
(*
(*       COMBUSTOR LINER NUGGET RECIPE
(*
(*        --  NUGGET INPUT DATA   --
(*          -  USER PROMPTS  -
(*
(*
PRINT X STARTING POINT (1) =
(*READ STARTX
  STARTX=0
(*
PRINT Y STARTING POINT (2) =
(*READ STARTY
  STARTY=5
(*
PRINT LENGTH OF BOTTOM LINE (3) =
(*READ LENGTH1
  LENGTH1=4.08
(*
PRINT LENGTH L2 (4) =
(*READ LENGTH2
  LENGTH2=.8
(*
PRINT LENGTH L3 (5) =
(*READ LENGTH3
  LENGTH3=.4
(*
PRINT LENGTH L4 (6) =
(*READ LENGTH4
  LENGTH4=.5
(*
PRINT LENGTH L5 (7) =
(*READ LENGTH5
LENGTH5=3.2
(*
PRINT LENGTH L6 (8) =
(*READ LENGTH6
  LENGTH6=1.77
(*
PRINT LENGTH L7 (9) =
(*READ LENGTH7
  LENGTH7=1.425
(*
PRINT LENGTH L8 (10)=
(*READ LENGTH8
  LENGTH8=4.5
(*
PRINT THICKNESS T1 (11) =
(*READ THICK1
  THICK1=.8
(*
PRINT THICKNESS T2 (12) =
```

```
(*READ THICK2
  THICK2=.55
(*
PRINT THICKNESS T3 (13) =
(*READ THICK3
  THICK3=.55
(*
PRINT THICKNESS T4 (14) =
(*READ THICK4
  THICK4=.55
(*
PRINT THICKNESS T5 (15) =
(*READ THICK5
  THICK5=1.003
(*
PRINT THETA1  (16) =
(*READ THETA1
  THETA1=90
THETA1=RADIAN(THETA1)
(*
PRINT THETA2  (17) =
(*READ THETA2
  THETA2=60
THETA2=RADIAN(THETA2)
(*
PRINT THETA3  (18) =
(*READ THETA3
  THETA3=180
THETA3=RADIAN(THETA3)
(*
PRINT RADIUS R1 (19) =
(*READ RADIUS1
  RADIUS1=1.0
(*
PRINT RADIUS R2 (20) =
(*READ RADIUS2
  RADIUS2=1.0
(*
PRINT RADIUS R3 (21) =
(*READ RADIUS3
  RADIUS3=1.15
(*
PRINT RADIUS R4 (22) =
(*READ RADIUS4
  RADIUS4=.75
(*
PRINT RADIUS R5 (23) =
(*READ RADIUS5
  RADIUS5=.6
(*
PRINT RADIUS R6 (24) =
(*READ RADIUS6
  RADIUS6=1.0
```

```
(*
PRINT ALPHA A1 (25) =
(*READ ALPHA1
  ALPHA1=0
ALPHA1=RADIAN(ALPHA1)
(*
PRINT ALPHA A2 (26) =
(*READ ALPHA2
  ALPHA2=90
ALPHA2=RADIAN(ALPHA2)
(*
PRINT PHI P1 (27) =
(*READ PHI1
  PHI1=15
PHI1=RADIAN(PHI1)
(*
(*
(*    - BURNER LINER NUGGET POINT DEFINITIONS -
(*       USE THE FOLLOWING EQUATIONS TO DEFINE
(*       ESMOSS POINT VALUES (2-D)
(*
(*   X-   = X COORDINATE VALUE
(*   Y-   = Y COORDINATE VALUE
(*   A-   = ANGLE REQUIRED TO REACH THE POINT FROM THE PREVIOUS POINT
(*
  PI=3.1415927
(*
  X1=STARTX
  Y1=STARTY
  A1=ALPHA1
(*
(*
  XTEMP=(THICK1/2)*SIN(PI+A1)
  YTEMP=(THICK1/2)*(1-COS(PI+A1))
  X2=XTEMP*COS(A1)-YTEMP*SIN(A1)+X1
  Y2=XTEMP*SIN(A1)+YTEMP*COS(A1)+Y1
  A2=A1
(*
(*
  X3=X2+LENGTH2*COS(A2)
  Y3=Y2+LENGTH2*SIN(A2)
  A3=A2
(*
  X4=X1+(X3-X2)
  Y4=Y1+(Y3-Y2)
  A4=A1
(*
  SEGMENT=(LENGTH1-LENGTH2-LENGTH3)/3
  X5=X4+SEGMENT*COS(A4)
  Y5=Y4+SEGMENT*SIN(A4)
  A5=A4
(*
  X8=X5+SEGMENT*COS(A5)
```

```
  Y8=Y5+SEGMENT*SIN(A5)
  A8=A5
(*
  X9=X8+SEGMENT*COS(A8)
  Y9=Y8+SEGMENT*SIN(A8)
  A9=A8
(*
  X12=X9+LENGTH3*COS(A9)
  Y12=Y9+LENGTH3*SIN(A9)
  A12=A9+(PI-ALPHA2)
(*
  X11=X12+THICK2*COS(A12)
  Y11=Y12+THICK2*SIN(A12)
  A11=A12+ALPHA2
(*
  X10=X11+LENGTH3*COS(A11)
  Y10=Y11+LENGTH3*SIN(A11)
  A10=A11
(*
(*
  XTEMP=RADIUS1*SIN(THETA1/4)
  YTEMP=RADIUS1*(1-COS(THETA1/4))
  X35=XTEMP*COS(A3)-YTEMP*SIN(A3)+X3
  Y35=XTEMP*SIN(A3)+YTEMP*COS(A3)+Y3
  A35=A3+THETA1/4
(*
  X6  =XTEMP*COS(A35)-YTEMP*SIN(A35)+X35
  Y6  =XTEMP*SIN(A35)+YTEMP*COS(A35)+Y35
  A6=A35+THETA1/4
(*
  X38=XTEMP*COS(A6)-YTEMP*SIN(A6)+X6
  Y38=XTEMP*SIN(A6)+YTEMP*COS(A6)+Y6
  A38=A6+THETA1/4
(*
  X14=XTEMP*COS(A38)-YTEMP*SIN(A38)+X38
  Y14=XTEMP*SIN(A38)+YTEMP*COS(A38)+Y38
  A14=A38+THETA1/4
(*
(*
  AA=A14-A10
  IF (AA > 0)
  THEN AA=AA-(2*PI)
  ENDIF
(*
(*
  XTEMP=-RADIUS2*SIN(AA/4)
  YTEMP=-RADIUS2*(1-COS(AA/4))
  X36=XTEMP*COS(A10)-YTEMP*SIN(A10)+X10
  Y36=XTEMP*SIN(A10)+YTEMP*COS(A10)+Y10
  A36=A10+AA/4
(*
  X7  =XTEMP*COS(A36)-YTEMP*SIN(A36)+X36
  Y7  =XTEMP*SIN(A36)+YTEMP*COS(A36)+Y36
```

```
  A7=A36+AA/4
(*
  X37=XTEMP*COS(A7)-YTEMP*SIN(A7)+X7
  Y37=XTEMP*SIN(A7)+YTEMP*COS(A7)+Y7
  A37=A7+AA/4
(*
(*
  X13=XTEMP*COS(A37)-YTEMP*SIN(A37)+X37
  Y13=XTEMP*SIN(A37)+YTEMP*COS(A37)+Y37
  A13=A37+AA/4
(*
  X15=X14+LENGTH4*COS(A14)
  Y15=Y14+LENGTH4*SIN(A14)
  A15=A14
(*
  D1=(X13-X15)*SIN(A15)
  D2=(Y13-Y15)*COS(A15)
  AT=ABS(D1-D2)
(*
  X16=X15-THICK4*COS(A15)
  Y16=Y15-THICK4*SIN(A15)
  A16=A15
  XTEMP=(-AT/2)*SIN(-PI)
  YTEMP=(-AT/2)*(1-COS(-PI))
  X16=XTEMP*COS(A16)-YTEMP*SIN(A16)+X16
  Y16=XTEMP*SIN(A16)+YTEMP*COS(A16)+Y16
  A16=A15
(*
  XTEMP=-RADIUS3*SIN(-PI/4)
  YTEMP=-RADIUS3*(1-COS(-PI/4))
  X40=XTEMP*COS(A15)-YTEMP*SIN(A15)+X15
  Y40=XTEMP*SIN(A15)+YTEMP*COS(A15)+Y15
  A40=A15-(PI/4)
(*
  X18=XTEMP*COS(A40)-YTEMP*SIN(A40)+X40
  Y18=XTEMP*SIN(A40)+YTEMP*COS(A40)+Y40
  A18=A40-(PI/4)
(*
(*
  XTEMP=-RADIUS3*SIN(-PI/4)
  YTEMP=-RADIUS3*(1-COS(-PI/4))
  X39=XTEMP*COS(A16)-YTEMP*SIN(A16)+X16
  Y39=XTEMP*SIN(A16)+YTEMP*COS(A16)+Y16
  A39=A16-(PI/4)
(*
  X17=XTEMP*COS(A39)-YTEMP*SIN(A39)+X39
  Y17=XTEMP*SIN(A39)+YTEMP*COS(A39)+Y39
  A17=A39-(PI/4)
(*
(*
  X19=X18+LENGTH5*COS(A18)
  Y19=Y18+LENGTH5*SIN(A18)
  A19=A18
```

```
(*
  X20=X17+LENGTH6*COS(A17)
  Y20=Y17-LENGTH6*SIN(A17)
  A20=A17
(*
(*
  XTEMP=-RADIUS4*SIN(-THETA3/6)
  YTEMP=-RADIUS4*(1-COS(-THETA3/6))
  X41=XTEMP*COS(A20)-YTEMP*SIN(A20)+X20
  Y41=XTEMP*SIN(A20)+YTEMP*COS(A20)+Y20
  A41=A20-THETA3/6
(*
  X21=XTEMP*COS(A41)-YTEMP*SIN(A41)+X41
  Y21=XTEMP*SIN(A41)+YTEMP*COS(A41)+Y41
  A21=A41-THETA3/6
(*
  X43=XTEMP*COS(A21)-YTEMP*SIN(A21)+X21
  Y43=XTEMP*SIN(A21)+YTEMP*COS(A21)+Y21
  A43=A21-THETA3/6
(*
  X24=XTEMP*COS(A43)-YTEMP*SIN(A43)+X43
  Y24=XTEMP*SIN(A43)+YTEMP*COS(A43)+Y43
  A24=A43-THETA3/6
(*
  X44=XTEMP*COS(A24)-YTEMP*SIN(A24)+X24
  Y44=XTEMP*SIN(A24)+YTEMP*COS(A24)+Y24
  A44=A24-THETA3/6
(*
  X27=XTEMP*COS(A44)-YTEMP*SIN(A44)+X44
  Y27=XTEMP*SIN(A44)+YTEMP*COS(A44)+Y44
  A27=A44-THETA3/6
(*
(*
  X28=X27+LENGTH7*COS(A27)
  Y28=Y27+LENGTH7*SIN(A27)
  A28=A27
(*
(*
  XTEMP=(THICK3/2)*SIN(PI/2)
  YTEMP=(THICK3/2)*(1-COS(PI/2))
  X45=XTEMP*COS(A28)-YTEMP*SIN(A28)+X28
  Y45=XTEMP*SIN(A28)+YTEMP*COS(A28)+Y28
  A45=A28+(PI/2)
(*
  X29=XTEMP*COS(A45)-YTEMP*SIN(A45)+X45
  Y29=XTEMP*SIN(A45)+YTEMP*COS(A45)+Y45
  A29=A45+(PI/2)
(*
(*
  X34=X29+LENGTH8*COS(A29)
  Y34=Y29+LENGTH8*SIN(A29)
  A34=A29
(*
```

```
(*
 XTEMP=-RADIUS5*SIN(-THETA2/2)
 YTEMP=-RADIUS5*(1-COS(-THETA2/2))
 X42=XTEMP*COS(A19)-YTEMP*SIN(A19)+X19
 Y42=XTEMP*SIN(A19)+YTEMP*COS(A19)+Y19
 A42=A19-THETA2/2
(*
 X22=XTEMP*COS(A42)-YTEMP*SIN(A42)+X42
 Y22=XTEMP*SIN(A42)+YTEMP*COS(A42)+Y42
 A22=A42-THETA2/2
(*
(*
 XTEMP=(THICK5/2)*SIN(PI)
 YTEMP=(THICK5/2)*(1-COS(PI))
 X33=XTEMP*COS(A34)-YTEMP*SIN(A34)+X34
 Y33=XTEMP*SIN(A34)+YTEMP*COS(A34)+Y34
 A33=A34+PI
(*
(*   A FEW CRITICAL POINTS NEED EXTRA CALCULATIONS
(*
 CS1=COS(A22)
 CS2=COS(A33)
 TA1=TAN(A22)
 TA2=TAN(A33)
(*
 IF (CS1 = 0.0)
   THEN
 X23=X22
 ENDIF
(*
 IF (CS2 = 0.0)
   THEN
 X23=X33
 ENDIF
(*
 CS3=CS1*CS2
(*IF (CS1 = 0.0 AND CS3 = 0.0)
(*  THEN
 Y23=Y33+(X23-X33)*TA2
(*  ELSE
(*Y23=Y22+(X23-X22)*TA1
(*ENDIF
 IF (X23=0.0)
   THEN
 X23=Y33-Y22+(X22*TA1)-(X33*TA2)
 X23=X23/(TA1-TA2)
 ENDIF
(*
 A23=A22
 YA=A34-A22
 IF (YA < 0)
   THEN
 YA=YA+(2*PI)
```

```
  ENDIF
(*
  D1=ABS(RADIUS6/TAN((PI-YA)/2))
  X23=X23-D1*COS(A23)
  Y23=Y23-D1*SIN(A23)
  A23=A23
(*
(*
  XTEMP=RADIUS6*SIN(YA/2)
  YTEMP=RADIUS6*(1-COS(YA/2))
  X46=XTEMP*COS(A23)-YTEMP*SIN(A23)+X23
  Y46=XTEMP*SIN(A23)+YTEMP*COS(A23)+Y23
  A46=A23+(YA/2)
(*
  X32=XTEMP*COS(A46)-YTEMP*SIN(A46)+X46
  Y32=XTEMP*SIN(A46)+YTEMP*COS(A46)+Y46
  A32=A46+(YA/2)
(*
(*
  X26=X29+(X27-X28)
  Y26=Y29+(Y27-Y28)
  A26=A29
(*
(*    A FEW CRITICAL POINTS NEED EXTRA CALCULATION
(*
  AX=X26-X29+X33-X32
  AY=ABS(Y26-Y29+Y33-Y32)
  AZ=COS(A29)
(*
  IF (AZ =0.0)
    THEN
  NULL=0
    ELSE
  AY=ABS(AX/AZ)
  ENDIF
(*
  X25=X26+((LENGTH8-AY)/3)*COS(A26)
  Y25=Y26+((LENGTH8-AY)/3)*SIN(A26)
  A25=A26
(*
  X30=X25+((LENGTH8-AY)/3)*COS(A25)
  Y30=Y25+((LENGTH8-AY)/3)*SIN(A25)
  A30=A25
(*
  X31=X30+((LENGTH8-AY)/3)*COS(A30)
  Y31=Y30+((LENGTH8-AY)/3)*SIN(A30)
  A31=A30
(*
(*
(*    - NUGGET POINT DEFINITIONS -
(*        DEFINE ESMOSS POINTS
(*
(*
```

```
SETMODEL (STARTX,STARTY,0,(X34+.1),(Y19+.1),0)
(*
 POINT (1,STARTX,STARTY,0)
 POINT (2,X2,Y2,0)
 POINT (3,X3,Y3,0)
 POINT (4,X4,Y4,0)
 POINT (5,X5,Y5,0)
 POINT (6,X6,Y6,0)
 POINT (7,X7,Y7,0)
 POINT (8,X8,Y8,0)
 POINT (9,X9,Y9,0)
 POINT (10,X10,Y10,0)
(*
 POINT (11,X11,Y11,0)
 POINT (12,X12,Y12,0)
 POINT (13,X13,Y13,0)
 POINT (14,X14,Y14,0)
 POINT (15,X15,Y15,0)
 POINT (16,X16,Y16,0)
 POINT (17,X17,Y17,0)
 POINT (18,X18,Y18,0)
 POINT (19,X19,Y19,0)
 POINT (20,X20,Y20,0)
(*
 POINT (21,X21,Y21,0)
 POINT (22,X22,Y22,0)
 POINT (23,X23,Y23,0)
 POINT (24,X24,Y24,0)
 POINT (25,X25,Y25,0)
 POINT (26,X26,Y26,0)
 POINT (27,X27,Y27,0)
 POINT (28,X28,Y28,0)
 POINT (29,X29,Y29,0)
 POINT (30,X30,Y30,0)
(*
 POINT (31,X31,Y31,0)
 POINT (32,X32,Y32,0)
 POINT (33,X33,Y33,0)
 POINT (34,X34,Y34,0)
 POINT (35,X35,Y35,0)
 POINT (36,X36,Y36,0)
 POINT (37,X37,Y37,0)
 POINT (38,X38,Y38,0)
 POINT (39,X39,Y39,0)
 POINT (40,X40,Y40,0)
(*
 POINT (41,X41,Y41,0)
 POINT (42,X42,Y42,0)
 POINT (43,X43,Y43,0)
 POINT (44,X44,Y44,0)
 POINT (45,X45,Y45,0)
 POINT (46,X46,Y46,0)
(*
```

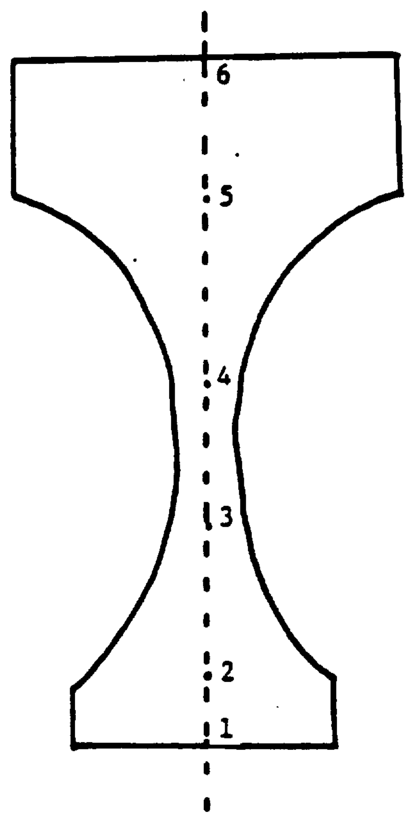
```
(*      - NUGGET CURVE DEFINITIONS -
(*          DEFINE ESMOSS CURVES
(*
  LINE    (1,1,2)
  LINE    (2,2,3)
  LINE    (3,3,4)
  LINF    (4,1,4)
(*
  LINE    (5,4,5)
  ARCCF    (6,3,6,35)
  LINE    (7,6,5)
(*
  LINE    (8,5,8)
  LINE    (9,6,7)
  LINE    (10,7,8)
(*
  LINE    (11,8,9)
  ARCCF    (12,7,10,36)
(*
  LINE    (13,10,9)
  LINE    (14,9,12)
  LINE    (15,10,11)
  LINE    (16,11,12)
(*
  ARCCF    (17,6,14,38)
  ARCCF    (18,7,13,37)
  LINE    (19,14,13)
(*
  LINE    (20,14,15)
  LINE    (21,13,16)
  LINE    (22,15,16)
(*
  ARCCF    (23,15,18,40)
  ARCCF    (24,16,17,39)
  LINE    (25,18,17)
(*
  LINE    (26,18,19)
  LINE    (27,17,20)
  LINE    (28,19,20)
(*
  ARCCF    (29,19,22,42)
  ARCCF    (30,20,21,41)
  LINE    (31,22,21)
(*
  ARCCF    (32,21,24,43)
  LINE    (33,22,23)
  LINE    (34,23,24)
(*
  ARCCF    (35,28,29,45)
  LINE    (36,27,28)
  LINE    (37,26,29)
(*
  LINE    (38,27,26)
```

```
  ARCCF    (39,24,27,44)
  LINE     (40,25,26)
  LINE     (41,24,25)
(*
  LINE     (42,30,25)
  LINE     (43,23,30)
(*
  ARCCF    (44,32,23,46)
  LINE     (45,31,30)
  LINE     (46,32,31)
(*
  LINE     (47,33,32)
  LINE     (48,34,31)
  LINE     (49,33,34)
(*
(*      - NUGGET SURFACE DEFINITIONS -
(*          DEFINE ESMOSS SURFACES
(*
  RULEDSRF (1,2,4)
  RULEDSRF (2,5,6)
  RULEDSRF (3,8,9)
  RULEDSRF (4,11,12)
  RULEDSRF (5,14,15)
  RULEDSRF (6,17,18)
  RULEDSRF (7,20,21)
  RULEDSRF (8,23,24)
  RULEDSRF (9,26,27)
  RULEDSRF (10,29,30)
  RULEDSRF (11,32,33)
  RULEDSRF (12,41,43)
  RULEDSRF (13,39,40)
  RULEDSRF (14,35,38)
  RULEDSRF (15,44,45)
  RULEDSRF (16,47,48)
(*
(*      - NUGGET REGION DEFINITIONS -
(*          DEFINE ESMOSS REGIONS
(*
  REG2D4S (1,1,1,2,3,4,1,2,3,4)
  REG2D4S (2,2,3,5,6,7,3,4,5,6)
  REG2D4S (3,3,7,8,9,10,5,6,7,8)
  REG2D4S (4,4,10,11,12,13,7,8,9,10)
  REG2D4S (5,5,13,14,15,16,10,9,12,11)
  REG2D4S (6,6,9,17,18,19,6,7,13,14)
  REG2D4S (7,7,19,20,21,22,13,14,15,16)
  REG2D4S (8,8,22,23,24,25,15,16,17,18)
  REG2D4S (9,9,25,26,27,28,17,18,19,20)
  REG2D4S (10,10,28,30,29,31,19,20,21,22)
  REG2D4S (11,11,31,32,33,34,21,22,23,24)
  REG2D4S (12,12,34,41,42,43,23,24,25,30)
  REG2D4S (13,13,39,38,41,40,24,27,26,25)
  REG2D4S (14,14,35,36,37,38,26,27,28,29)
  REG2D4S (15,15,44,43,46,45,23,30,31,32)
```

```
  REG2D4S (16,16,46,47,48,49,31,32,33,34)
(*
(* DISCRETIZE REGIONS
(*
  DIS2DREG (1)
  DISEDGE  (1,3)
  DISEDGE  (2,3)
  ENDISCRT
(*
  DIS2DREG (2)
  DISEDGE  (5,3)
  DISEDGE  (3,3)
  ENDISCRT
(*
  DIS2DREG (3)
  DISEDGE  (8,3)
  DISEDGE  (7,3)
  ENDISCRT
(*
  DIS2DREG (4)
  DISEDGE  (10,3)
  DISEDGE  (11,3)
  ENDISCRT
(*
  DIS2DREG (5)
  DISEDGE  (13,3)
  DISEDGE  (14,3)
  ENDISCRT
(*
  DIS2DREG (6)
  DISEDGE  (9,3)
  DISEDGE  (18,3)
  ENDISCRT
(*
  DIS2DREG (7)
  DISEDGE  (19,3)
  DISEDGE  (21,3)
  ENDISCRT
(*
  DIS2DREG (8)
  DISEDGE  (22,3)
  DISEDGE  (23,3)
  ENDISCRT
(*
  DIS2DREG (9)
  DISEDGE  (25,3)
  DISEDGE  (27,3)
  ENDISCRT
(*
  DIS2DREG (10)
  DISEDGE  (30,3)
  DISEDGE  (28,3)
  ENDISCRT
```

```
(*
  DIS2DREG (11)
  DISEDGE  (31,3)
  DISEDGE  (32,3)
  ENDISCRT
(*
  DIS2DREG (12)
  DISEDGE  (34,3)
  DISEDGE  (41,3)
  ENDISCRT
(*
  DIS2DREG (13)
  DISEDGE  (40,3)
  DISEDGE  (38,3)
  ENDISCRT
(*
  DIS2DREG (14)
  DISEDGE  (36,3)
  DISEDGE  (38,3)
  ENDISCRT
(*
  DIS2DREG (15)
  DISEDGE  (45,3)
  DISEDGE  (43,3)
  ENDISCRT
(*
  DIS2DREG (16)
  DISEDGE  (46,3)
  DISEDGE  (47,3)
  ENDISCRT
(*
  END RECIPE
```

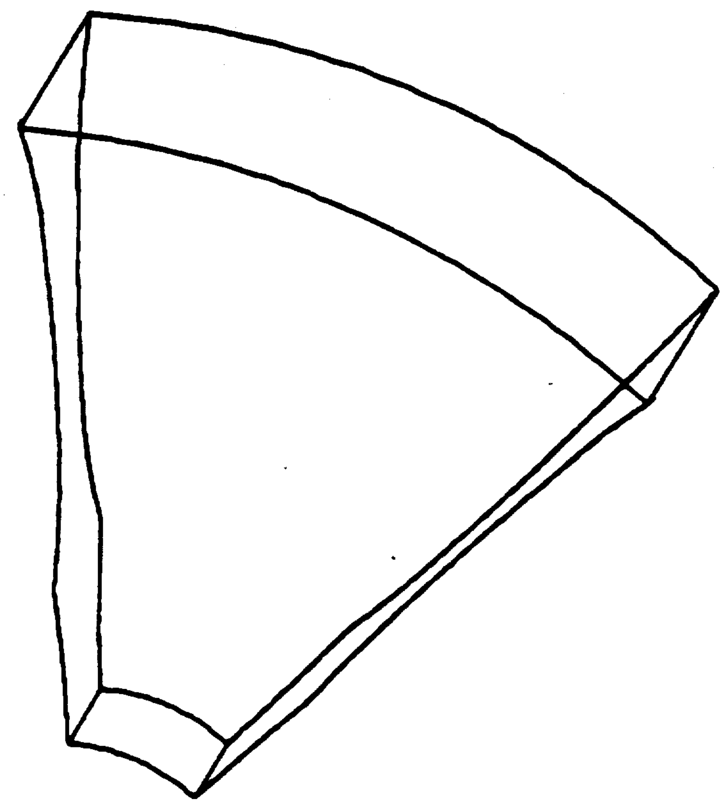
Disk - Parametric Model



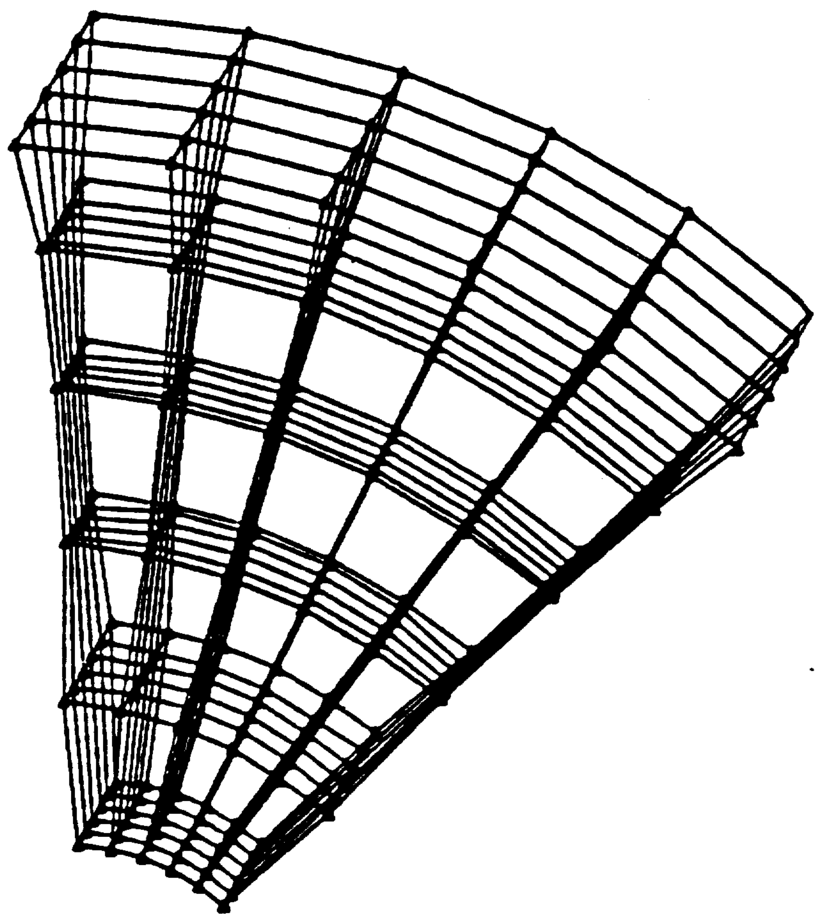
If Arc Radius = 0, Connect by Straight Line from Prior Point

If Arc Radius > 0, Connect by Circular Arc from Prior Point

Disk - Geometric Model



Disk - Discrete Model



```
(*
(*                         FAN DISC RECIPE
(*
(*                     -- DISC INPUT DATA --
(*                        - USER PROMPTS -
(*
(*                    DEFINE THE DISC CROSS-SECTION
(*
PRINT INPUT THE ANGLE OF THE CROSS-SECTION TO VIEW THE DISC
PRINT ANGLE MUST BE GREATER THAN 0, AND LESS THAN 90 DEGRESS
(*READ ANGLE
ANGLE=45
PRINT THERE ARE 6 INPUT POINTS USED TO DEFINE THE DISC CROSS-SECTION
PRINT THE RADIUS OF EACH POINT IS MEASURED FROM THE CENTER OF THE DISC
PRINT THE THICKNESS IS MEASURED FROM THE POINT TO THE TOP EDGE
PRINT OF THE DISC
PRINT THE ARC RADIUS DETERMINES THE CURVATURE OF THE DISC
PRINT IF ARC RADIUS = 0, CONNECT BY STRAIGHT LINE FROM THE PRIOR POINT
PRINT IF ARC RADIUS > 0, CONNECT BY CIRCULAR ARC FROM THE PRIOR POINT
PRINT TO THE PRESENT POINT
PRINT
PRINT INPUT FIRST POINT -  RADIUS, THICKNESS, ARC RADIUS
(*READ RADIUS1
(*READ THICK1
(*READ ARC1
  RADIUS1=2
  THICK1=.7
  ARC1=0
(*
PRINT INPUT SECOND POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ RADIUS2
(*READ THICK2
(*READ ARC2
  RADIUS2=4
  THICK2=1.0
  ARC2=3
(*
PRINT INPUT THIRD POINT -  RADIUS, THICKNESS, ARC RADIUS
(*READ RADIUS3
(*READ THICK3
(*READ ARC3
  RADIUS3=6
  THICK3=.5
  ARC3=1.75
(*
PRINT INPUT FOURTH POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ RADIUS4
(*READ THICK4
(*READ ARC4
  RADIUS4=8
  THICK4=.70
  ARC4=4
```

```
(*
PRINT INPUT FIFTH POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ RADIUS5
(*READ THICK5
(*READ ARC5
  RADIUS5=10
  THICK5=1.5
  ARC5=2
(*
PRINT INPUT SIXTH POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ RADIUS6
(*READ THICK6
(*READ ARC6
  RADIUS6=12
  THICK6=1.5
  ARC6=0
(*
(*
(*****************************************************************
(*
(*   DEFINE MACRO TO CALCULATE ARC CENTER POINT
(*   THE ARC CONNECTS 2 EDGE POINTS ON THE DISC
(*
  DEFINE CNTR-PT
(*
  RKSQ=RK*RK
  XMK=XM-XK
  YMK=YM-YK
  DISTSQ=XMK*XMK +YMK*YMK
(*
  SUMRSQ=RKSQ*2
  ROOT=2*SUMRSQ*DISTSQ - DISTSQ*DISTSQ
  DSTINV=.5/DISTSQ
  SCL=.5
(*
  X=XMK*SCL +XK
  Y=YMK*SCL +YK
  ROOT=DSTINV*SQRT(ROOT)
(*
  XFAC=XMK*ROOT
  YFAC=YMK*ROOT
(*
(* THE 2 ROOTS OF THE EQUATIONS FOLLOW - 2 POINTS AND A RADIUS
(* DEFINE 2 POSSIBLE CENTER POINTS.
(*
  XL=X+YFAC
  YL=Y-XFAC
(*
  XR=X-YFAC
  YR=Y+XFAC
(*
  END CNTR-PT
(*
```

```
(*****************************************************************
(*
(* DEFINE MACRO TO DEFINE ROTATED POINTS ON THE DISC
(*
  DEFINE ROTATE
(*
  ANG=ANGLE*(3.1415927/180)
  RY1=RY*COS(ANG)-RZ*SIN(ANG)
  RZ1=RZ*COS(ANG)+RY*SIN(ANG)
  RY=RY1
  RZ=RZ1
(*
  END ROTATE
(*
(* DEFINE MACRO TO ROTATE POINTS 4/10 OF THE CROSS-SECTION
(*
  DEFINE ROT4TEN
(*
  RANG=ANG*.4
  RY1=RY*COS(RANG)-RZ*SIN(RANG)
  RZ1=RZ*COS(RANG)+RY*SIN(RANG)
  RY=RY1
  RZ=RZ1
(*
  END ROT4TEN
(*
(* DEFINE MACRO TO ROTATE POINTS 6/10 OF THE CROSS-SECTION
(*
  DEFINE ROT6TEN
(*
  SANG=ANG*.6
  RY1=RY*COS(SANG)-RZ*SIN(SANG)
  RZ1=RZ*COS(SANG)+RY*SIN(SANG)
  RY=RY1
  RZ=RZ1
(*
  END ROT6TEN
(*
(*****************************************************************
(*
(*             CALCULATE POINT COORDINATE VALUES X-Y PLANE
(*
  X1=THICK1
  Y1=RADIUS1
(*
  X2=THICK2
  Y2=RADIUS2
(*
  X3=THICK3
  Y3=RADIUS3
(*
  X4=THICK4
  Y4=RADIUS4
```

```
C*
  X5=THICK5
  Y5=RADIUS5
C*
  X6=THICK6
  Y6=RADIUS6
C*
C*      CALCULATE POINT COORDINATE VALUES FOR ROTATED CROSS-SECTION
C*
  RZ=0
  RY=Y1
  ROTATE
  YT=RY
  ZT=RZ
C*
C*
  RZ=0
  RY=Y1
  ROTATE
  Y51=RY
  Z51=RZ
C*
C*
  RZ=0
  RY=Y1
  ROT4TEN
  Y101=RY
  Z101=RZ
C*
  RZ=0
  RY=Y1
  ROT6TEN
  Y151=RY
  Z151=RZ
C*
  RZ=0
  RY=Y2
  ROTATE
  Y52=RY
  Z52=RZ
C*
C*
  RZ=0
  RY=Y2
  ROT4TEN
  Y102=RY
  Z102=RZ
C*
  RZ=0
  RY=Y2
  ROT6TEN
  Y152=RY
  Z152=RZ
```

```
(*
  RZ=0
  RY=Y3
  ROTATE
  Y53=RY
  Z53=RZ
(*
(*
  RZ=0
  RY=Y3
  ROT4TEN
  Y103=RY
  Z103=RZ
(*
  RZ=0
  RY=Y3
  ROT6TEN
  Y153=RY
  Z153=RZ
(*
  RZ=0
  RY=Y4
  ROTATE
  Y54=RY
  Z54=RZ
(*
(*
  RZ=0
  RY=Y4
  ROT4TEN
  Y104=RY
  Z104=RZ
(*
  RZ=0
  RY=Y4
  ROT6TEN
  Y154=RY
  Z154=RZ
(*
  RZ=0
  RY=Y5
  ROTATE
  Y55=RY
  Z55=RZ
(*
(*
  RZ=0
  RY=Y5
  ROT4TEN
  Y105=RY
  Z105=RZ
(*
  RZ=0
```

```
  RY=Y5
  ROT6TEN
  Y155=RY
  Z155=RZ
(*
  RZ=0
  RY=Y6
  ROTATE
  Y56=RY
  Z56=RZ
(*
(*
  RZ=0
  RY=Y6
  ROT4TEN
  Y106=RY
  Z106=RZ
(*
  RZ=0
  RY=Y6
  ROT6TEN
  Y156=RY
  Z156=RZ
(*
(*                                                                  *
(*******************************************************************
(*                                                                  *
(*                     - DISC POINT DEFINITIONS -                   *
(*                        DEFINE ESMOSS POINTS                      *
(*                                                                  *
(*     P1-6   RIGHT SIDE OF DISC (X-Y PLANE)                        *
(*     P6-12  LEFT  SIDE OF DISC (X-Y PLANE) MIRROR IMAGE OF RIGHT SIDE*
(*     P13-22 ARC CENTER POINTS FOR DISC CURVATURE CALCULATIONS     *
(*                                                                  *
(*     P51-56 RIGHT SIDE OF DISC (ROTATED PLANE)                    *
(*     P57-62 LEFT  SIDE OF DISC (ROTATED PLANE)                    *
(*     P63-72 ARC CENTER POINTS FOR DISC CURVATURE CALCULATIONS (FOR *
(*            ROTATED PLANE                                         *
(*                                                                  *
(*     P101-152 DEFINE POINTS TO GENERATE THE 2 MIDDLE              *
(*            CROSS-SECTIONS                                        *
(*                                                                  *
(*     P500-  CENTER POINTS TO GENERATE ARCS THAT CONNECT           *
(*     P503   CROSS SECTIONS OF THE DISC                            *
(*                                                                  *
(*******************************************************************
(*
  SETMODEL (-X6,Y1,0,X6,Y6,Z56)
(*
  POINT (1,X1,Y1,0)
  POINT (2,X2,Y2,0)
  POINT (3,X3,Y3,0)
  POINT (4,X4,Y4,0)
```

```
POINT (5,X5,Y5,0)
POINT (6,X6,Y6,0)
POINT (7,-X1,Y1,0)
POINT (8,-X2,Y2,0)
POINT (9,-X3,Y3,0)
POINT (10,-X4,Y4,0)
POINT (11,-X5,Y5,0)
POINT (12,-X6,Y6,0)
(*
POINT (51,X1,Y51,Z51)
POINT (52,X2,Y52,Z52)
POINT (53,X3,Y53,Z53)
POINT (54,X4,Y54,Z54)
POINT (55,X5,Y55,Z55)
POINT (56,X6,Y56,Z56)
POINT (57,-X1,Y51,Z51)
POINT (58,-X2,Y52,Z52)
POINT (59,-X3,Y53,Z53)
POINT (60,-X4,Y54,Z54)
POINT (61,-X5,Y55,Z55)
POINT (62,-X6,Y56,Z56)
(*
POINT (101,X1,Y101,Z101)
POINT (102,X2,Y102,Z102)
POINT (103,X3,Y103,Z103)
POINT (104,X4,Y104,Z104)
POINT (105,X5,Y105,Z105)
POINT (106,X6,Y106,Z106)
POINT (107,-X1,Y101,Z101)
POINT (108,-X2,Y102,Z102)
POINT (109,-X3,Y103,Z103)
POINT (110,-X4,Y104,Z104)
POINT (111,-X5,Y105,Z105)
POINT (112,-X6,Y106,Z106)
(*
POINT (151,X1,Y151,Z151)
POINT (152,X2,Y152,Z152)
POINT (153,X3,Y153,Z153)
POINT (154,X4,Y154,Z154)
POINT (155,X5,Y155,Z155)
POINT (156,X6,Y156,Z156)
POINT (157,-X1,Y151,Z151)
POINT (158,-X2,Y152,Z152)
POINT (159,-X3,Y153,Z153)
POINT (160,-X4,Y154,Z154)
POINT (161,-X5,Y155,Z155)
POINT (162,-X6,Y156,Z156)
(*
POINT (500,X1,0,0)
POINT (501,-X1,0,0)
POINT (502,X6,0,0)
POINT (503,-X6,0,0)
(*
```

```
(*
  RK=3
  XK=1
  YK=1
  XM=2
  YM=2
  CNTR-PT
  X13=XL
  Y13=YL
(*
(*
(*            DEFINE ARC CENTER POINTS FOR CURVES
(*                   IF ARC RADIUS IS > 0.
(*
(*
(* DEFINE POINTS TO CONNECT FIRST AND SECOND VALUES
(*
  IF (ARC2 > 0)
  THEN
    RK=ARC2
    XK=X1
    YK=Y1
    XM=X2
    YM=Y2
    CNTR-PT
    X13=XL
    Y13=YL
    POINT (13,X13,Y13,0)
    POINT (18,-X13,Y13,0)
(*
    RZ=0
    RY=Y13
    ROTATE
    Y63=RY
    Z63=RZ
    POINT (63,X13,Y63,Z63)
    POINT (68,-X13,Y63,Z63)
(*
    RZ=0
    RY=Y13
    ROT4TEN
    Y113=RY
    Z113=RZ
    POINT (113,X13,Y113,Z113)
    POINT (118,-X13,Y113,Z113)
(*
    RZ=0
    RY=Y13
    ROT6TEN
    Y163=RY
    Z163=RZ
    POINT (163,X13,Y163,Z163)
    POINT (168,-X13,Y163,Z163)
```

```
  ENDIF
(*
(*   DEFINE POINTS TO CONNECT SECOND AND THIRD VALUES
(*
  IF (ARC3 > 0)
  THEN
    RK=ARC3
    XK=X2
    YK=Y2
    XM=X3
    YM=Y3
    CNTR-PT
    X14=XL
    Y14=YL
    POINT (14,X14,Y14,0)
    POINT (19,-X14,Y14,0)
(*
    RZ=0
    RY=Y14
    ROTATE
    Y64=RY
    Z64=RZ
    POINT (64,X14,Y64,Z64)
    POINT (69,-X14,Y64,Z64)
(*
    RZ=0
    RY=Y14
    ROT4TEN
    Y114=RY
    Z114=RZ
    POINT (114,X14,Y114,Z114)
    POINT (119,-X14,Y114,Z114)
(*
    RZ=0
    RY=Y14
    ROT6TEN
    Y164=RY
    Z164=RZ
    POINT (164,X14,Y164,Z164)
    POINT (169,-X14,Y164,Z164)
  ENDIF
(*
(*   DEFINE POINTS TO CONNECT THIRD AND FOURTH VALUES
(*
  IF (ARC4 > 0)
  THEN
    RK=ARC4
    XK=X3
    YK=Y3
    XM=X4
    YM=Y4
    CNTR-PT
    X15=XL
```

```
    Y15=YL
    POINT (15,X15,Y15,0)
    POINT (20,-X15,Y15,0)
(*
    RZ=0
    RY=Y15
    ROTATE
    Y65=RY
    Z65=RZ
    POINT (65,X15,Y65,Z65)
    POINT (70,-X15,Y65,Z65)
(*
    RZ=0
    RY=Y15
    ROT4TEN
    Y115=RY
    Z115=RZ
    POINT (115,X15,Y115,Z115)
    POINT (120,-X15,Y115,Z115)
(*
    RZ=0
    RY=Y15
    ROT6TEN
    Y165=RY
    Z165=RZ
    POINT (165,X15,Y165,Z165)
    POINT (170,-X15,Y165,Z165)
  ENDIF
(*
(*   DEFINE POINTS TO CONNECT FOURTH AND FIFTH VALUES
(*
  IF (ARC5 > 0)
  THEN
    RK=ARC5
    XK=X4
    YK=Y4
    XM=X5
    YM=Y5
    CNTR-PT
    X16=XL
    Y16=YL
    POINT (16,X16,Y16,0)
    POINT (21,-X16,Y16,0)
(*
    RZ=0
    RY=Y16
    ROTATE
    Y66=RY
    Z66=RZ
    POINT (66,X16,Y66,Z66)
    POINT (71,-X16,Y66,Z66)
(*
    RZ=0
```

```
    RY=Y16
    ROT4TEN
    Y116=RY
    Z116=RZ
    POINT (116,X16,Y116,Z116)
    POINT (121,-X16,Y116,Z116)
(*
    RZ=0
    RY=Y16
    ROT6TEN
    Y166=RY
    Z166=RZ
    POINT (166,X16,Y166,Z166)
    POINT (171,-X16,Y166,Z166)
  ENDIF
(*
(*   DEFINE POINTS TO CONNECT FIFTH AND SIXTH VALUES
(*
  IF (ARC6 > 0)
  THEN
    RK=ARC6
    XK=X5
    YK=Y5
    XM=X6
    YM=Y6
    CNTR-PT
    X17=XL
    Y17=YL
    POINT (17,X17,Y17,0)
    POINT (22,-X17,Y17,0)
(*
    RZ=0
    RY=Y17
    ROTATE
    Y67=RY
    Z67=RZ
    POINT (67,X17,Y67,Z67)
    POINT (72,-X17,Y67,Z67)
(*
    RZ=0
    RY=Y17
    ROT4TEN
    Y117=RY
    Z117=RZ
    POINT (117,X17,Y117,Z117)
    POINT (122,-X17,Y117,Z117)
(*
    RZ=0
    RY=Y17
    ROT6TEN
    Y167=RY
    Z167=RZ
    POINT (167,X17,Y167,Z167)
```

```
    POINT (172 -X17.Y167 Z167)
  ENDIF
(*
(*****************************************************************
(*
(*                      - DISC CURVE DEFINITIONS
(*                        DEFINE ESMOSS CURVES
(*
(*****************************************************************
(*
(*    IF ARC = 0. THEN CONNECT POINTS BY LINES
(*                ELSE CONNECT POINTS BY ARCS
(*
  IF (ARC2 = 0)
  THEN
    LINE (1,1,2)
    LINE (6,7,8)
    LINE (51,51,52)
    LINE (56,57,58)
    LINE (101,101,102)
    LINE (106,107,108)
    LINE (151,151,152)
    LINE (156,157,158)
  ELSE
    ARC (1,13,1,2)
    ARC (6,18,7,8)
    ARC (51,63,51,52)
    ARC (56,68,57,58)
    ARC (101,113,101,102)
    ARC (106,118,107,108)
    ARC (151,163,151,152)
    ARC (156,168,157,158)
  ENDIF
(*
(* IF ARC3 = 0. THEN CONNECT POINTS BY LINES.
(*                ELSE CONNECT POINTS BY ARCS
(*
  IF (ARC3 = 0)
  THEN
    LINE (2,2,3)
    LINE (7,8,9)
    LINE (52,52,53)
    LINE (57,58,59)
    LINE (102,102,103)
    LINE (107,108,109)
    LINE (152,152,153)
    LINE (157,158,159)
  ELSE
    ARC (2,14,2,3)
    ARC (7,19,8,9)
    ARC (52,64,52,53)
    ARC (57,69,58,59)
    ARC (102,114,102,103)
```

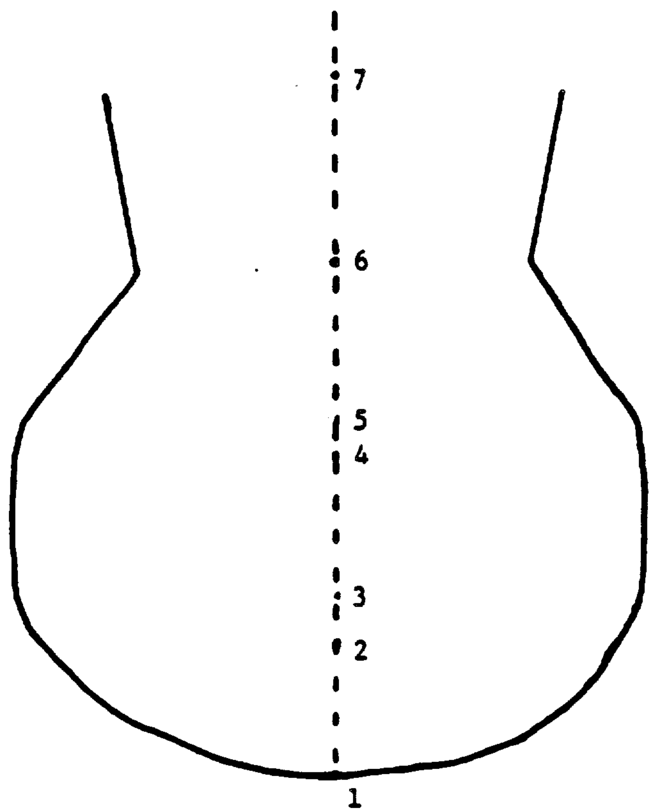
```
    ARC (107,119,108,109)
    ARC (152,164,152,153)
    ARC (157,169,158,159)
  ENDIF
(*
(*  IF ARC4 = 0, THEN CONNECT POINTS BY LINES,
(*                ELSE CONNECT POINTS BY ARCS
(*
  IF (ARC4 = 0)
  THEN
    LINE (3,3,4)
    LINE (8,9,10)
    LINE (53,53,54)
    LINE (58,59,60)
    LINE (103,103,104)
    LINE (108,109,110)
    LINE (153,153,154)
    LINE (158,159,160)
  ELSE
    ARC (3,15,3,4)
    ARC (8,20,9,10)
    ARC (53,65,53,54)
    ARC (58,70,59,60)
    ARC (103,115,103,104)
    ARC (108,120,109,110)
    ARC (153,165,153,154)
    ARC (158,170,159,160)
  ENDIF
(*
(*  IF ARC5 = 0, THEN CONNECT POINTS BY LINES,
(*                ELSE CONNECT POINTS BY ARCS
(*
  IF (ARC5 = 0)
  THEN
    LINE (4,4,5)
    LINE (9,10,11)
    LINE (54,54,55)
    LINE (59,60,61)
    LINE (104,104,105)
    LINE (109,110,111)
    LINE (154,154,155)
    LINE (159,160,161)
  ELSE
    ARC (4,16,4,5)
    ARC (9,21,10,11)
    ARC (54,66,54,55)
    ARC (59,71,60,61)
    ARC (104,116,104,105)
    ARC (109,121,110,111)
    ARC (154,166,154,155)
    ARC (159,171,160,161)
  ENDIF
(*
```

```
(* IF ARC6 = 0. THEN CONNECT POINTS BY LINES
(*               ELSE CONNECT POINTS BY ARCS
(*
  IF (ARC6 = 0)
  THEN
  LINE (5,5,6)
  LINE (10,11,12)
  LINE (55,55,56)
  LINE (60,61,62)
  LINE (105,105,106)
  LINE (110,111,112)
  LINE (155,155,156)
  LINE (160,161,162)
  ELSE
  ARC (5,17,5,6)
  ARC (10,22,11,12)
  ARC (55,67,55,56)
  ARC (60,72,61,62)
  ARC (105,117,105,106)
  ARC (110,122,111,112)
  ARC (155,167,155,156)
  ARC (160,172,161,162)
  ENDIF
(*
(*
  LINE (11,1,7)
  LINE (12,5,11)
  LINE (61,51,57)
  LINE (62,55,61)
(*
  LINE (111,101,107)
  LINE (112,105,111)
  LINE (161,151,157)
  LINE (162,155,161)
(*
(* COMBINE THE 5 CROSS-SECTION CURVES INTO ONE CURVE
(*            IN ORDER TO DEFINE SURFACES
(*
  MRGCURVE (20,1,2)
  MRGCURVE (21,20,3)
  MRGCURVE (22,21,4)
(*
  MRGCURVE (70,51,52)
  MRGCURVE (71,70,53)
  MRGCURVE (72,71,54)
(*
  MRGCURVE (24,6,7)
  MRGCURVE (25,24,8)
  MRGCURVE (26,25,9)
(*
  MRGCURVE (74,56,57)
  MRGCURVE (75,74,58)
  MRGCURVE (76,75,59)
```

```
(*
  MRGCURVE (120,101,102)
  MRGCURVE (121,120,103)
  MRGCURVE (122,121,104)
(*
  MRGCURVE (170,151,152)
  MRGCURVE (171,170,153)
  MRGCURVE (172,171,154)
(*
  MRGCURVE (124,106,107)
  MRGCURVE (125,124,108)
  MRGCURVE (126,125,109)
(*
(*
(*     CONNECT DISC CROSS-SECTION BY ARCS
(*
(*
  ARC (200,501,7,107)
  ARC (201,500,1,101)
  ARC (202,503,11,111)
  ARC (203,502,5,105)
(*
(*
  ARC (210,501,107,157)
  ARC (211,500,101,151)
  ARC (212,503,111,161)
  ARC (213,502,105,155)
(*
(*
  ARC (220,501,157,57)
  ARC (221,500,151,51)
  ARC (222,503,161,61)
  ARC (223,502,155,55)
(*
(*****************************************************************
(*                                                               *
(*                - DISC SURFACE DEFINITIONS -                   *
(*                   DEFINE ESMOSS SURFACES                      *
(*                                                               *
(*****************************************************************
(*
  XAXIS=1
(*
  REVOLVE (1,XAXIS,22,(ANGLE*.4))
  REVOLVE (2,XAXIS,26,(ANGLE*.4))
  REVOLVE (3,XAXIS,11,(ANGLE*.4))
  REVOLVE (4,XAXIS,12,(ANGLE*.4))
(*
  MRGCURVE (174,156,157)
  MRGCURVE (175,174,158)
  MRGCURVE (176,175,159)
(*
  DELETEPT (16)
```

```
DELETECV (20)
DELETECV (21)
DELETECV (70)
DELETECV (71)
DELETECV (24)
DELETECV (25)
DELETECV (74)
DELETECV (75)
DELETECV (120)
DELETECV (121)
DELETECV (170)
DELETECV (171)
DELETECV (124)
DELETECV (125)
DELETECV (174)
DELETECV (175)
RULEDSRF (5.22,26)
RULEDSRF (6.122.126)
(*
(*
REVOLVE (7,XAXIS,122,(ANGLE*.2))
REVOLVE (8.XAXIS.126,(ANGLE*.2))
REVOLVE (9,XAXIS,111,(ANGLE*.2))
REVOLVE (10.XAXIS.112.(ANGLE*.2))
(*
RULEDSRF (11.172,176)
(*
(*
REVOLVE (12.XAXIS.172.(ANGLE*.4))
REVOLVE (13.XAXIS.176.(ANGLE*.4))
REVOLVE (14.XAXIS.161,(ANGLE*.4))
REVOLVE (15.XAXIS.162.(ANGLE*.4))
(*
RULEDSRF (16.72.76)
(*
(*****************************************************************
(*                                                               *
(*                  - DISC REGION DEFINITIONS -                  *
(*                    DEFINE ESMOSS REGIONS                      *
(*                                                               *
(*****************************************************************
(*
REG3D (1. 1. 2. 3. 4, 5. 6, &
          200,201.202,203. 22. 26. 122.126. 11. 12. 111,112. &
          1. 7. 101.107. 5. 11. 105,111)
(*
REG3D (2. 6. 7. 8. 9. 10. 11. &
          210,211,212,213,122,126,172,176,111.112,161.162. &
          101,107,151,157,105,111,155,161)
(*
REG3D (3. 11. 12. 13. 14. 15. 16. &
          220,221,222,223,172,176. 72. 76, 61, 62. 161,162. &
          151,157. 51, 57. 155.161. 55. 61)
```

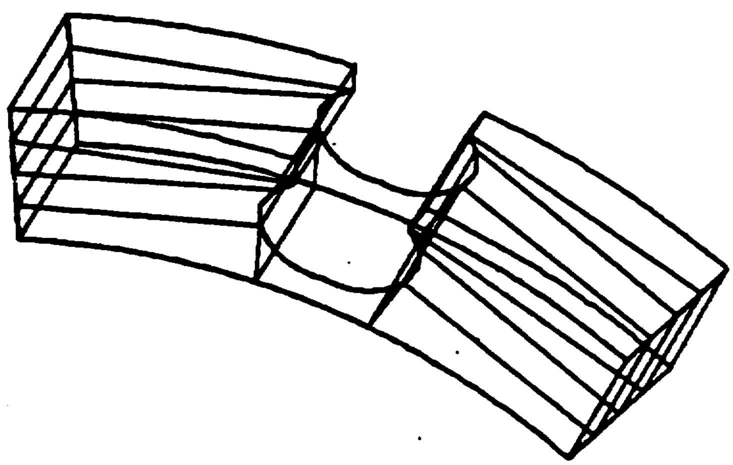
```
(**********************************************************************
(*                                                                    *
(*                     - DISCRETIZE REGION                            *
(*                                                                    *
(**********************************************************************
(*
  PRINT INPUT THE NUMBER OF NODES PER EDGE
(* READ DNODE
  DNODE=3
(*
  DIS8NBRK (1)
  DISEDGE (22,DNODE)
  DISEDGE (200.DNODE)
  DISEDGE (11,DNODE)
  ENDISCRT
(*
  DIS8NBRK (2)
(*
  DISEDGE (210.DNODE)
  DISEDGE (122.DNODE)
  DISEDGE (111.DNODE)
  ENDISCRT
(*
  DIS8NBRK (3)
(*
  DISEDGE (220.DNODE)
  DISEDGE (172.DNODE)
  DISEDGE (161.DNODE)
  ENDISCRT
(*
  END RECIPE
```



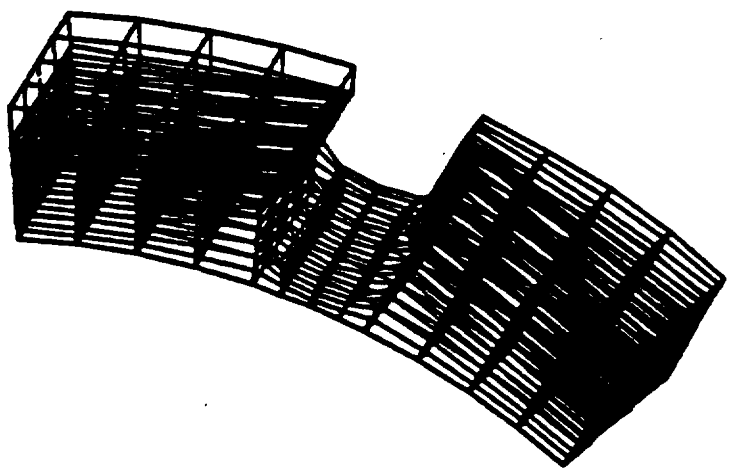
Arc Radius = 0, Connect by Straight Line with Prior Point

Arc Radius < 0, Connect by Circular Arc with Prior Point

Broach - Geometric Model



Broach - Discrete Model



```
(*
(*                          BROACH  RECIPE
(*
(*                     -- BROACH INPUT DATA  --
(*                        -  USER PROMPTS  -
(*
(*                  DEFINE THE TOP OF THE DISC
(*
PRINT INPUT THE ANGLE OF THE CROSS-SECTION TO VIEW THE BROACH
PRINT ANGLE MUST BE GREATER THAN 0, AND LESS THAN 90 DEGRESS
PRINT AND MUST CORRESPOND EXACTLY TO THE VALUE GIVEN FOR THE DISC
(*READ ANGLE
  ANGLE=45
(*
  PRINT DEFINE THE TOP PART OF THE DISC - - THESE VALUES MUST BE
  PRINT EXACTLY THE SAME AS THE DISC
  PRINT
(*
  PRINT INPUT FIFTH POINT - RADIUS, THICKNESS
(*READ RADIUS5
(*READ THICK5
  RADIUS5=10
  THICK5=1.5
(*
  PRINT INPUT SIXTH POINT - RADIUS
(*READ RADIUS6
  RADIUS6=12
  THICK6=THICK5
(*
(*
(*                          DEFINE THE BROACH
(*
(*
PRINT NOW DEFINE THE PARAMETERS FOR THE BROACH
PRINT
PRINT THERE ARE 7 INPUT POINTS USED TO DEFINE THE BROACH CROSS-SECTION
PRINT POINT 1 DEFINES THE BOTTOM OF THE BROACH
PRINT POINT 7 DEFINES THE SHAPE AT THE TOP EDGE OF THE DISC
PRINT THE RADIUS OF EACH POINT IS MEASURED FROM THE TOP EDGE OF THE DISC
PRINT THE THICKNESS IS MEASURED FROM THE CENTER-LINE POINT TO THE SIDE
PRINT OF THE BROACH
PRINT THE ARC RADIUS DETERMINES THE CURVATURE OF THE BROACH
PRINT IF ARC RADIUS = 0, CONNECT BY STRAIGHT LINE FROM THE PRIOR POINT
PRINT IF ARC RADIUS < 0, CONNECT BY CIRCULAR ARC FROM THE PRIOR POINT
PRINT
PRINT NOTE -- THE ARC RADIUS FOR POINT 7 HAS A DEFAULT VALUE OF 0,
PRINT         AND IS THEREFORE A STRAIGHT LINE.
PRINT
PRINT INPUT FIRST BROACH POINT -  RADIUS, THICKNESS, ARC RADIUS
(*READ BRADIUS1
(*READ BTHICK1
(*READ BARC1
```

```
  BRADIUS1=1.6
  BTHICK1=0
  BARC1=0
(*
PRINT INPUT SECOND BROACH POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ BRADIUS2
(*READ BTHICK2
(*READ BARC2
  BRADIUS2=1.4
  BTHICK2=.8
  BARC2=-1
(*
PRINT INPUT THIRD BROACH POINT -  RADIUS, THICKNESS, ARC RADIUS
(*READ BRADIUS3
(*READ BTHICK3
(*READ BARC3
  BRADIUS3=1.2
  BTHICK3=1.0
  BARC3=-2
(*
PRINT INPUT FOURTH BROACH POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ BRADIUS4
(*READ BTHICK4
(*READ BARC4
  BRADIUS4=.9
  BTHICK4=1.10
  BARC4=-3.5
(*
PRINT INPUT FIFTH BROACH POINT -  RADIUS, THICKNESS, ARC RADIUS
(*READ BRADIUS5
(*READ BTHICK5
(*READ BARC5
  BRADIUS5=.60
  BTHICK5=1.0
  BARC5=-2
(*
PRINT INPUT SIXTH BROACH POINT -  RADIUS, THICKNESS, ARC RADIUS
(*READ BRADIUS6
(*READ BTHICK6
(*READ BARC6
  BRADIUS6=.4
  BTHICK6=.8
  BARC6=-4
(*
PRINT INPUT SEVENTH BROACH POINT- RADIUS, THICKNESS
(*READ BRADIUS7
(*READ BTHICK7
  BRADIUS7=0
  BTHICK7=.9
  BARC7=0
(****************************************************************
(*
(*   DEFINE MACRO TO CALCULATE ARC CENTER POINT
```

```
(*
 DEFINE CNTR-PT
(*
 RKSQ=RK*RK
 XMK=XM-XK
 YMK=YM-YK
 DISTSQ=XMK*XMK +YMK*YMK
(*
 SUMRSQ=RKSQ*2
 ROOT=2*SUMRSQ*DISTSQ - DISTSQ*DISTSQ
 DSTINV=.5/DISTSQ
 SCL=.5
(*
 X=XMK*SCL +XK
 Y=YMK*SCL +YK
 ROOT=DSTINV*SQRT(ROOT)
(*
 XFAC=XMK*ROOT
 YFAC=YMK*ROOT
(*
(* THE 2 ROOTS OF THE EQUATIONS FOLLOW - 2 POINTS AND A RADIUS
(* DEFINE 2 POSSIBLE CENTER POINTS.
(*
 XL=X+YFAC
 YL=Y-XFAC
 XR=X-YFAC
 YR=Y+XFAC
(*
 END CNTR-PT
(*
(*****************************************************************
(*
(* DEFINE MACRO TO DEFINE ROTATED POINTS
(*
 DEFINE ROTATE
(*
 ANG=ANGLE*(3.1415927/180)
 RY1=RY*COS(ANG)-RZ*SIN(ANG)
 RZ1=RZ*COS(ANG)+RY*SIN(ANG)
 RY=RY1
 RZ=RZ1
(*
 END ROTATE
(*
(*****************************************************************
(*
(*            CALCULATE POINT COORDINATE VALUES X-Y PLANE
(*
 X5=THICK5
 Y5=RADIUS5
(*
 X6=THICK6
 Y6=RADIUS6
```

```
(*
(*      CALCULATE POINT COORDINATE VALUES FOR ROTATED CROSS-SECTION
(*
  RZ=0
  RY=Y6
  ROTATE
  YT=RY
  ZT=RZ
(*
  RZ=0
  RY=Y5
  ROTATE
  Y55=RY
  Z55=RZ
(*
  RZ=0
  RY=Y6
  ROTATE
  Y56=RY
  Z56=RZ
(*
  Y200=Y5+(((Y6-Y5)*3)/4)
  RZ=0
  RY=Y200
  ROTATE
  Y202=RY
  Z202=RZ
(*
  Y205=Y5+((Y6-Y5)/2)
  RZ=0
  RY=Y205
  ROTATE
  Y207=RY
  Z207=RZ
(*
  Y210=Y5+((Y6-Y5)/4)
  RZ=0
  RY=Y210
  ROTATE
  Y212=RY
  Z212=RZ
(*
  SETMODEL (-X6,Y1,0,X6,Y6,Z56)
(*
  POINT (5,X5,Y5,0)
  POINT (6,X6,Y6,0)
  POINT (11,-X5,Y5,0)
  POINT (12,-X6,Y6,0)
  POINT (55,X5,Y55,Z55)
  POINT (56,X6,Y56,Z56)
  POINT (61,-X5,Y55,Z55)
  POINT (62,-X6,Y56,Z56)
(*
```

```
 POINT (200.X6.Y200.0)
 POINT (201.-X6.Y200.0)
 POINT (202.X6.Y202.Z202)
 POINT (203.-X6.Y202.Z202)
(*
 POINT (205.X6.Y205.0)
 POINT (206.-X6.Y205.0)
 POINT (207.X6.Y207.Z207)
 POINT (208.-X6.Y207.Z207)
(*
 POINT (210.X6.Y210.0)
 POINT (211.-X6.Y210.0)
 POINT (212.X6.Y212.Z212)
 POINT (213.-X6.Y212.Z212)
(*
 POINT (502.X6.0.0)
 POINT (503.-X6.0.0)
(*
(*
 RK=3
 XK=1
 YK=1
 XM=2
 YM=2
 CNTR-PT
 X13=XL
 Y13=YL
(*
(*****************************************************************
(*                                                               *
(*            NOW START TO DEFINE THE BROACH                     *
(*                                                               *
(*****************************************************************
(*
(* CALCULATE POINT COORDINATE VALUES
(*
 ANGLE=ANGLE/2
(*
 RY=Y6-BRADIUS1
 RZ=BTHICK1
 ROTATE
 Y101=RY
 Z101=RZ
(*
 RY=Y6-BRADIUS2
 RZ=BTHICK2
 ROTATE
 Y102=RY
 Z102=RZ
(*
 RY=Y6-BRADIUS3
 RZ=BTHICK3
 ROTATE
```

```
Y103=RY
Z103=RZ
(*
RY=Y6-BRADIUS4
RZ=BTHICK4
ROTATE
Y104=RY
Z104=RZ
(*
RY=Y6-BRADIUS5
RZ=BTHICK5
ROTATE
Y105=RY
Z105=RZ
(*
RY=Y6-BRADIUS6
RZ=BTHICK6
ROTATE
Y106=RY
Z106=RZ
(*
RY=Y6-BRADIUS7
RZ=BTHICK7
ROTATE
Y107=RY
Z107=RZ
(*
RY=Y6-BRADIUS2
RZ=-BTHICK2
ROTATE
Y108=RY
Z108=RZ
(*
RY=Y6-BRADIUS3
RZ=-BTHICK3
ROTATE
Y109=RY
Z109=RZ
(*
RY=Y6-BRADIUS4
RZ=-BTHICK4
ROTATE
Y110=RY
Z110=RZ
(*
RY=Y6-BRADIUS5
RZ=-BTHICK5
ROTATE
Y111=RY
Z111=RZ
(*
RY=Y6-BRADIUS6
RZ=-BTHICK6
```

```
ROTATE
Y112=RY
Z112=RZ
(*
RY=Y6-BRADIUS7
RZ=-BTHICK7
ROTATE
Y113=RY
Z113=RZ
(*
(*
(******************************************************************
(*                                                                *
(*          - -  BROACH POINT DEFINITIONS  - -                    *
(*                 DEFINE ESMOSS POINTS                           *
(*                                                                *
(*  P101-107  RIGHT SIDE OF THE BROACH                            *
(*  P108-113  LEFT  SIDE OF THE BROACH (MIRROR IMAGE)             *
(*  P114-125  ARC CENTER POINTS FOR BROACH CURVATURE CALCULATIONS*
(*                                                                *
(*  P151-157  RIGHT SIDE OF THE BROACH (OFFSET)                   *
(*  P158-163  LEFT  SIDE OF THE BROACH (OFFSET)                   *
(*  P164-175  ARC CENTER POINTS FOR BROACH CURVATURE CALCULATIONS*
(*            FOR OFFSET                                          *
(*                                                                *
(******************************************************************
(*
(*
 X12=-X6
(*
 POINT (101,X12,Y101,Z101)
 POINT (102,X12,Y102,Z102)
 POINT (103,X12,Y103,Z103)
 POINT (104,X12,Y104,Z104)
 POINT (105,X12,Y105,Z105)
 POINT (106,X12,Y106,Z106)
 POINT (107,X12,Y107,Z107)
(*
 POINT (108,X12,Y108,Z108)
 POINT (109,X12,Y109,Z109)
 POINT (110,X12,Y110,Z110)
 POINT (111,X12,Y111,Z111)
 POINT (112,X12,Y112,Z112)
 POINT (113,X12,Y113,Z113)
(*
 POINT (151,X6,Y101,Z101)
 POINT (152,X6,Y102,Z102)
 POINT (153,X6,Y103,Z103)
 POINT (154,X6,Y104,Z104)
 POINT (155,X6,Y105,Z105)
 POINT (156,X6,Y106,Z106)
 POINT (157,X6,Y107,Z107)
(*
```

```
  POINT (158.X6.Y108.Z108)
  POINT (159.X6.Y109.Z109)
  POINT (160.X6.Y110.Z110)
  POINT (161.X6.Y111.Z111)
  POINT (162.X6.Y112.Z112)
  POINT (163.X6.Y113.Z113)
(*
(*              DEFINE CENTER POINTS FOR CURVES
(*              IF ARC RADIUS IS > 0
(*
(*  DEFINE POINTS TO CONNECT FIRST AND SECOND POINTS IF NECESSARY
(*
(*
  IF (BARC2 < 0)
  THEN
    RK=-BARC2
    XK=Z101
    YK=Y101
    XM=Z102
    YM=Y102
    CNTR-PT
    Z114=XR
    Y114=YR
    POINT (114.X12.Y114.Z114)
    POINT (164.X6.Y114.Z114)
    XK=Z101
    YK=Y101
    XM=Z108
    YM=Y108
    CNTR-PT
    Z120=XL
    Y120=YL
    POINT (120.X12.Y120.Z120)
    POINT (170.X6.Y120.Z120)
(*
  ENDIF
(*
(*  DEFINE POINTS TO CONNECT SECOND AND THIRD VALUES
(*
  IF (BARC3 < 0)
  THEN
    RK=-BARC3
    XK=Z102
    YK=Y102
    XM=Z103
    YM=Y103
    CNTR-PT
    Z115=XR
    Y115=YR
    POINT (115.X12.Y115.Z115)
    POINT (165.X6.Y115.Z115)
    XK=Z108
    YK=Y108
```

```
    XM=Z109
    YM=Y109
    CNTR-PT
    Z121=XL
    Y121=YL
    POINT (121,X12,Y121,Z121)
    POINT (171,X6,Y121,Z121)
(*
  ENDIF
(*
(*   DEFINE POINTS TO CONNECT THIRD AND FOURTH VALUES
(*
  IF (BARC4 < 0)
  THEN
    RK=-BARC4
    XK=Z103
    YK=Y103
    XM=Z104
    YM=Y104
    CNTR-PT
    Z116=XR
    Y116=YR
    POINT (116,X12,Y116,Z116)
    POINT (166,X6,Y116,Z116)
    XK=Z109
    YK=Y109
    XM=Z110
    YM=Y110
    CNTR-PT
    Z122=XL
    Y122=YL
    POINT (122,X12,Y122,Z122)
    POINT (172,X6,Y122,Z122)
(*
  ENDIF
(*
(*   DEFINE POINTS TO CONNECT FOURTH AND FIFTH VALUES
(*
  IF (BARC5 < 0)
  THEN
    RK=-BARC5
    XK=Z104
    YK=Y104
    XM=Z105
    YM=Y105
    CNTR-PT
    Z117=XR
    Y117=YR
    POINT (117,X12,Y117,Z117)
    POINT (167,X6,Y117,Z117)
    XK=Z110
    YK=Y110
    XM=Z111
```

```
    YM=Y111
    CNTR-PT
    Z123=XL
    Y123=YL
    POINT (123,X12,Y123,Z123)
    POINT (173,X6,Y123,Z123)
(*
  ENDIF
(*
(*   DEFINE POINTS TO CONNECT FIFTH AND SIXTH VALUES
(*
  IF (BARC6 < 0)
  THEN
    RK=-BARC6
    XK=Z105
    YK=Y105
    XM=Z106
    YM=Y106
    CNTR-PT
    Z118=XR
    Y118=YR
    POINT (118,X12,Y118,Z118)
    POINT (168,X6,Y118,Z118)
    XK=Z111
    YK=Y111
    XM=Z112
    YM=Y112
    CNTR-PT
    Z124=XL
    Y124=YL
    POINT (124,X12,Y124,Z124)
    POINT (174,X6,Y124,Z124)
(*
  ENDIF
(*
(*   DEFINE POINTS TO CONNECT SIXTH AND SEVENTH VALUES
(*
  IF (BARC7 < 0)
  THEN
    RK=-BARC7
    XK=Z106
    YK=Y106
    XM=Z107
    YM=Y107
    CNTR-PT
    Z119=XR
    Y119=YR
    POINT (119,X12,Y119,Z119)
    POINT (169,X6,Y119,Z119)
    XK=Z112
    YK=Y112
    XM=Z113
    YM=Y113
```

```
    CNTR-PT
    Z125=XL
    Y125=YL
    POINT (125,X12,Y125,Z125)
    POINT (175,X6,Y125,Z125)
(*
  ENDIF
(*
(*********************************************************************
(*                                                                   *
(*                  - BROACH CURVE DEFINITIONS -                     *
(*                     DEFINE ESMOSS CURVES                          *
(*                                                                   *
(*********************************************************************
(*
(*   IF BARC = 0, THEN CONNECT POINTS BY LINES
(*                ELSE CONNECT POINTS BY ARCS
(*
  IF (BARC2 = 0)
  THEN
    LINE (101,101,102)
    LINE (107,108,101)
    LINE (151,151,152)
    LINE (157,158,151)
  ELSE
    ARC (101,114,101,102)
    ARC (107,120,108,101)
    ARC (151,164,151,152)
    ARC (157,170,158,151)
  ENDIF
(*
(* IF BARC3 = 0, THEN CONNECT POINTS BY LINES,
(*               ELSE CONNECT POINTS BY ARCS
(*
  IF (BARC3 = 0)
  THEN
    LINE (102,102,103)
    LINE (108,109,108)
    LINE (152,152,153)
    LINE (158,159,158)
  ELSE
    ARC (102,115,102,103)
    ARC (108,121,109,108)
    ARC (152,165,152,153)
    ARC (158,171,159,158)
  ENDIF
(*
(* IF BARC4 = 0, THEN CONNECT POINTS BY LINES,
(*               ELSE CONNECT POINTS BY ARCS
(*
  IF (BARC4 = 0)
  THEN
    LINE (103,103,104)
```

```
    LINE (109,109,110)
    LINE (153,153,154)
    LINE (159,159,160)
  ELSE
    ARC (103,116,103,104)
    ARC (109,122,109,110)
    ARC (153,166,153,154)
    ARC (159,172,159,160)
  ENDIF
(*
(* IF BARC5 = 0, THEN CONNECT POINTS BY LINES,
(*                ELSE CONNECT POINTS BY ARCS
(*
  IF (BARC5 = 0)
  THEN
    LINE (104,104,105)
    LINE (110,110,111)
    LINE (154,154,155)
    LINE (160,160,161)
  ELSE
    ARC (104,117,104,105)
    ARC (110,123,110,111)
    ARC (154,167,154,155)
    ARC (160,173,160,161)
  ENDIF
(*
(* IF BARC6 = 0, THEN CONNECT POINTS BY LINES,
(*                ELSE CONNECT POINTS BY ARCS
(*
  IF (BARC6 = 0)
  THEN
    LINE (105,105,106)
    LINE (111,111,112)
    LINE (155,155,156)
    LINE (161,161,162)
  ELSE
    ARC (105,118,105,106)
    ARC (111,124,111,112)
    ARC (155,168,155,156)
    ARC (161,174,161,162)
  ENDIF
(*
(* IF BARC7 = 0, THEN CONNECT POINTS BY LINES,
(*                ELSE CONNECT POINTS BY ARCS
(*
  IF (BARC7 = 0)
  THEN
    LINE (106,106,107)
    LINE (112,112,113)
    LINE (156,156,157)
    LINE (162,162,163)
  ELSE
    ARC (106,119,106,107)
```

```
    ARC (112,125,112,113)
    ARC (156,169,156,157)
    ARC (162,175,162,163)
  ENDIF
(*
(*
(*     CONNECT DISC CROSS-SECTION BY ARCS
(*
(*
  ARC (202,503,12,113)
  ARC (203,503,107,62)
  ARC (204,502,6,163)
  ARC (205,502,157,56)
(*
  ARC (210,502,5,55)
  ARC (211,503,11,61)
(*
(*     DEFINE TOP CROSS-SECTION PIECE WITH STRAIGHT LINES
(*
  LINE (212,5,6)
  LINE (213,11,12)
  LINE (214,55,56)
  LINE (215,61,62)
  LINE (220,11,5)
  LINE (221,12,6)
  LINE (222,61,55)
  LINE (223,62,56)
(*
(*     CONNECT BROACH POINTS
(*
  LINE (230,113,163)
  LINE (231,107,157)
  LINE (232,106,156)
  LINE (233,112,162)
  LINE (234,103,153)
  LINE (235,109,159)
  LINE (236,12,201)
  LINE (237,6,200)
  LINE (238,11,211)
  LINE (239,5,210)
  LINE (240,56,202)
  LINE (241,62,203)
  LINE (242,55,212)
  LINE (243,61,213)
  LINE (244,111,161)
  LINE (245,105,155)
(*
  PARMCRV (900,210,.4)
  PARMCRV (901,210,.6)
  PARMCRV (902,211,.4)
  PARMCRV (903,211,.6)
(*
  ARC (250,502,5,900)
```

```
  ARC (251,502,900,901)
  ARC (252,502,901,55)
  ARC (253,503,11,902)
  ARC (254,503,902,903)
  ARC (255,503,903,61)
(*
  LINE (260,11,211)
  LINE (261,5,210)
  LINE (262,55,212)
  LINE (263,61,213)
(*
(*     CONSTRUCT LINES TO DEFINE REGION BOUNDARIES
(*
  LINE (300,200,162)
  LINE (301,201,112)
  LINE (302,156,202)
  LINE (303,106,203)
(*
  LINE (310,210,159)
  LINE (311,211,109)
  LINE (312,153,212)
  LINE (313,103,213)
  LINE (315,205,161)
  LINE (316,206,111)
  LINE (317,155,207)
  LINE (318,105,208)
(*
  LINE (320,201,200)
  LINE (321,203,202)
  LINE (322,211,210)
  LINE (323,213,212)
(*
  LINE (325,210,205)
  LINE (326,211,206)
  LINE (327,212,207)
  LINE (328,213,208)
(*
  LINE (330,900,159)
  LINE (331,901,153)
  LINE (332,902,109)
  LINE (333,903,103)
(*
  LINE (334,205,200)
  LINE (335,206,201)
  LINE (336,207,202)
  LINE (337,208,203)
  LINE (338,206,205)
  LINE (339,208,207)
(*
  LINE (340,900,902)
  LINE (341,901,903)
(*
(*     MERGE BROACH CURVES INTO ONE CURVE TO DEFINE A SURFACE
```

```
(*
  MRGCURVE (400.109.110)
  MRGCURVE (401.103.104)
  MRGCURVE (402.159.160)
  MRGCURVE (403.153.154)
(*
  MRGCURVE (410.108.107)
  MRGCURVE (411.410.101)
  MRGCURVE (412,411,102)
(*
  MRGCURVE (420,158,157)
  MRGCURVE (421.420,151)
  MRGCURVE (422,421,152)
(*
(**************************************************************
(*                                                            *
(*                - BROACH SURFACE DEFINITIONS -              *
(*                   DEFINE ESMOSS SURFACES                   *
(*                                                            *
(**************************************************************
(*
(*          DEFINE SURFACES FOR REGION 1
(*
  RULEDSRF (1,250,253)
  RULEDSRF (2,310,311)
  RULEDSRF (3,260,261)
  RULEDSRF (4,330,332)
  RULEDSRF (5,250.310)
  RULEDSRF (6,253.311)
(*
(*          DEFINE SURFACES FOR REGION 2
(*
  RULEDSRF (7,251,254)
  RULEDSRF (8.412.422)
  RULEDSRF (9,412,254)
  RULEDSRF (10.422,251)
(*
(*          DEFINE SURFACES FOR REGION 3
(*
  RULEDSRF (11,252,255)
  RULEDSRF (12.312.313)
  RULEDSRF (13,262,263)
  RULEDSRF (14.331,333)
  RULEDSRF (15.252.312)
  RULEDSRF (16,255,313)
(*
(*          DEFINE SURFACES FOR REGION 4
(*
  RULEDSRF (20,202,204)
  RULEDSRF (21,300.301)
  RULEDSRF (22,202,301)
  RULEDSRF (23,204,300)
  RULEDSRF (24.320.221)
```

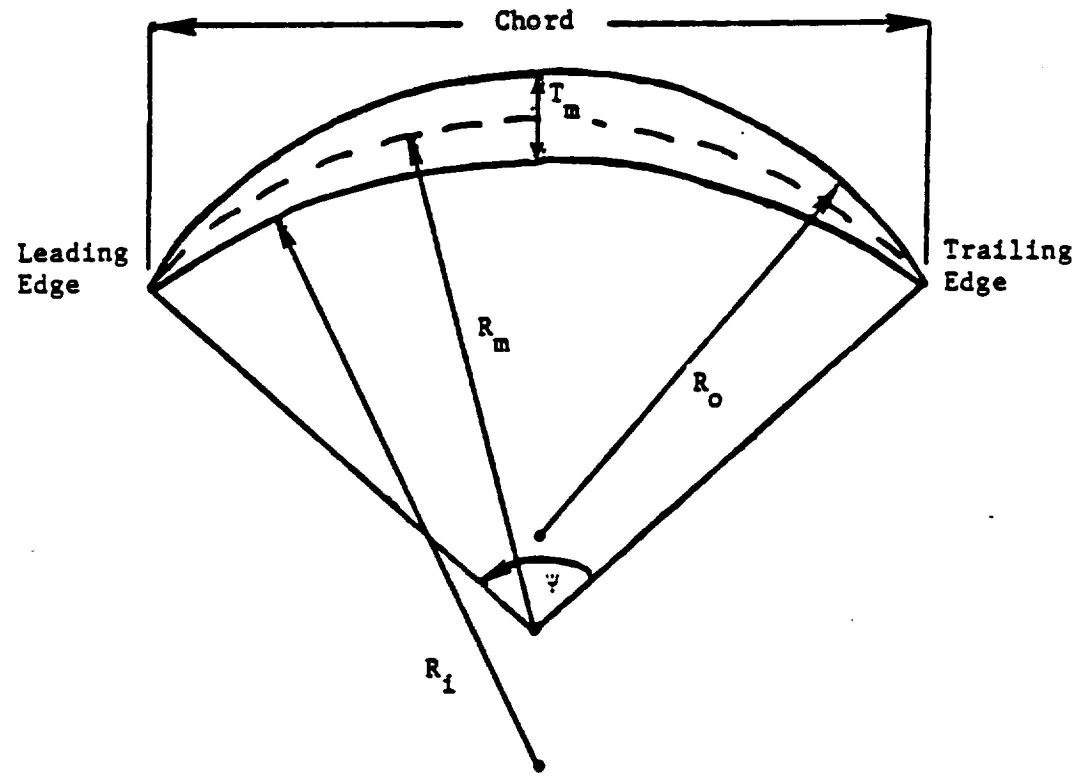
ORIGINAL PAGE IS
OF POOR QUALITY

```
 RULEDSRF (25,230,233)
(*
(*          DEFINE SURFACES FOR REGION 5
(*
 RULEDSRF (30,334,335)
 RULEDSRF (31,111,335)
 RULEDSRF (32,161,334)
 RULEDSRF (33,161,111)
(*
(*          DEFINE SURFACES FOR REGION 6
(*
 RULEDSRF (35,400,326)
 RULEDSRF (36,402,325)
 RULEDSRF (37,400,402)
 RULEDSRF (38,322,338)
 RULEDSRF (39,316,315)
(*
(*          DEFINE SURFACES FOR REGION 7
(*
 RULEDSRF (40,203,205)
 RULEDSRF (41,302,303)
 RULEDSRF (42,203,303)
 RULEDSRF (43,205,302)
 RULEDSRF (44,321,223)
 RULEDSRF (45,231,232)
(*
(*          DEFINE SURFACES FOR REGION 8
(*
 RULEDSRF (50,339,321)
 RULEDSRF (51,105,337)
 RULEDSRF (52,155,336)
 RULEDSRF (53,105,155)
(*
(*          DEFINE SURFACES FOR REGION 9
(*
 RULEDSRF (54,339,323)
 RULEDSRF (55,401,328)
 RULEDSRF (56,403,327)
 RULEDSRF (57,401,403)
 RULEDSRF (58,245,339)
(*
(*
(**********************************************************
(*                                                        *
(*              - BROACH REGION DEFINITIONS -             *
(*                 DEFINE ESMOSS REGIONS                  *
(*                                                        *
(**********************************************************
(*
(*               DEFINE  REGION 1
(*
 REG3D (1, 1, 2, 3, 4, 5, 6, &
       322, 235, 330, 332, 250, 253, 260, 261, 310, 311, 340, 220, &
```

```
        5, 11, 159, 109, 210, 211, 900, 902)
(*
(*              DEFINE  REGION 2
(*
 REG3D (2, 7, 8, 4, 14, 9, 10, &
        412, 422, 251, 254, 330, 331, 332, 333, 235, 234, 340, 341, &
        900, 901, 109, 159, 902, 903, 103, 153)
(*
(*              DEFINE  REGION 3
(*
 REG3D (3, 11, 12, 13, 14, 15, 16, &
        323, 234, 331, 333, 252, 255, 262, 263, 312, 313, 222, 341, &
        55, 61, 153, 103, 212, 213, 901, 903)
(*
(*              DEFINE  REGION 4
(*
 REG3D (4, 20, 21, 22, 23, 24, 25, &
        202, 204, 300, 301, 320, 221, 230, 233, 236, 237, 112, 162, &
        6, 12, 200, 201, 113, 163, 112, 162)
(*
(*              DEFINE  REGION 5
(*
 REG3D (5, 21, 30, 31, 32, 33, 39, &
        233, 244, 300, 301, 320, 315, 111, 161, 338, 334, 335, 316, &
        111, 112, 161, 162, 205, 206, 200, 201)
(*
(*              DEFINE  REGION 6
(*
 REG3D (6,  2, 35, 36, 37, 38, 39, &
        400, 402, 235, 244, 310, 311, 322, 338, 325, 326, 315, 316, &
        109, 111, 159, 161, 210, 211, 205, 206)
(*
(*              DEFINE  REGION 7
(*
 REG3D (7, 40, 41, 42, 43, 44, 45, &
        231, 232, 223, 321, 302, 205, 303, 203, 106, 156, 240, 241, &
        106, 156, 107, 157, 56, 62, 202, 203)
(*
(*              DEFINE  REGION 8
(*
 REG3D (8, 41, 50, 51, 52, 53, 58, &
        232, 245, 302, 303, 321, 317, 105, 155, 339, 336, 337, 318, &
        105, 106, 155, 156, 207, 208, 202, 203)
(*
(*              DEFINE  REGION 9
(*
 REG3D (9, 54, 55, 56, 57, 58, 12, &
        401, 403, 234, 245, 312, 313, 323, 339, 328, 327, 317, 318, &
        103, 105, 153, 155, 212, 213, 207, 208)
(*
(*              DISCRETIZE REGIONS 1 - 7
(*
 PRINT INPUT THE NUMBER OF NODES PER EDGE
```

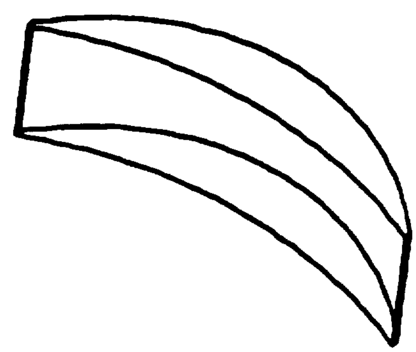
```
(* READ BNODE
  BNODE=3
(*
  DIS8NBRK (1)
  DISEDGE  (330.BNODE)
  DISEDGE  (310.BNODE)
  DISEDGE  (220.BNODE)
  ENDISCRT
(*
  DIS8NBRK (2)
  DISEDGE  (412.BNODE)
  DISEDGE  (330.BNODE)
  DISEDGE  (340.BNODE)
  ENDISCRT
(*
  DIS8NBRK (3)
  DISEDGE  (323.BNODE)
  DISEDGE  (252.BNODE)
  ENDISCRT
(*
  DIS8NBRK (4)
  DISEDGE  (202.BNODE)
  DISEDGE  (300.BNODE)
  DISEDGE  (320.BNODE)
  ENDISCRT
(*
  DIS8NBRK (5)
  DISEDGE  (111.BNODE)
  DISEDGE  (334.BNODE)
  DISEDGE  (338.BNODE)
  ENDISCRT
(*
  DIS8NBRK (6)
  DISEDGE  (400.BNODE)
  DISEDGE  (338.BNODE)
  DISEDGE  (325.BNODE)
  ENDISCRT
(*
  DIS8NBRK (7)
  DISEDGE  (223.BNODE)
  DISEDGE  (303.BNODE)
  DISEDGE  (106..BNODE)
  ENDISCRT
(*
  DIS8NBRK (8)
  DISEDGE  (105.BNODE)
  DISEDGE  (339.BNODE)
  DISEDGE  (336.BNODE)
  ENDISCRT
(*
  DIS8NBRK (9)
  DISEDGE  (401.BNODE)
  DISEDGE  (234.BNODE)
```

```
DISEDGE   (312.BNODE)
DISEDGE   (339.BNODE)
DISEDGE   (327.BNODE)
DISEDGE   (317.BNODE)
ENDISCRT
('
END RECIPE
```

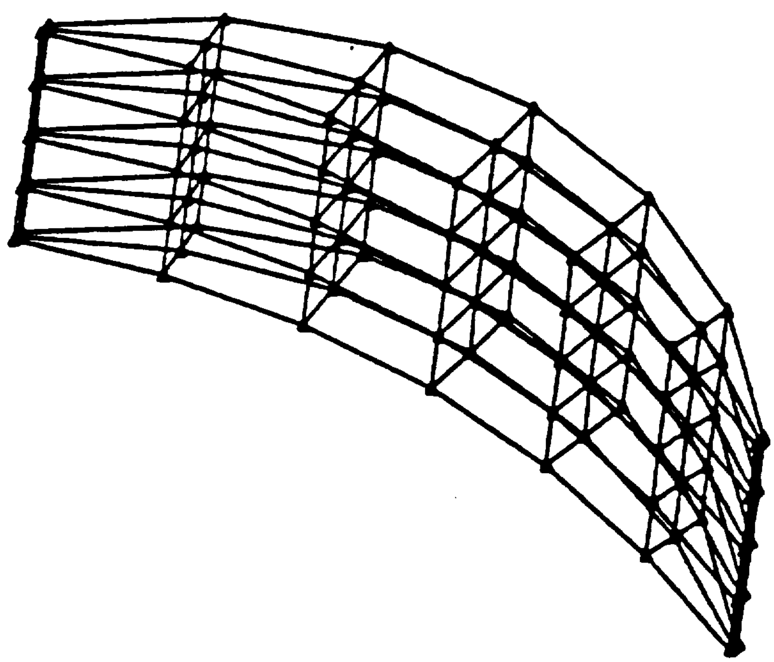


- ψ ~ Camber Angle
- C ~ Chord
- t_m/C - Maximum Thickness/Chord
- Section Height
- Section Offset

Airfoil Geometric Model



Airfoil Discrete Model



```
(*
(*                         AIRFOIL RECIPE
(*
(*                   --  AIRFOIL INPUT DATA  --
(*                        -  USER PROMPTS  -
(*
(*
 PRINT INPUT THE CAMBER ANGLE OF THE AIRFOIL IN DEGREES
(*READ CAMBER
 CAMBER=60
(*
 PRINT INPUT THE CHORD LENGTH OF THE AIRFOIL
(*READ CHORD
 CHORD=10
(*
 PRINT INPUT THE MAXIMUM THICKNESS DIVIDED BY THE CHORD LENGTH
(*READ THICKCH
 THICKCH=.9
(*
 PRINT INPUT THE SECTION HEIGHT
(*READ HEIGHT
 HEIGHT=4
(*
 PRINT INPUT THE SECTION OFFSET
(*READ OFFSET
 OFFSET=.5
(*
(*
(*       RECIPE CALCULATIONS TO DEFINE THE AIRFOIL
(*
(*       RADIUSM = RADIUS TO DEFINE THE MIDDLE OF THE AIRFOIL
(*       RADIUSI = RADIUS TO DEFINE THE INNER ARC OF THE AIRFOIL
(*       RADIUSO = RADIUS TO DEFINE THE OUTER ARC OF THE AIRFOIL
(*
 THICK = CHORD*THICKCH
 CAMBER = RADIAN(CAMBER)
 X1=0
 Y1=0
(*
 RADIUSM = CHORD/(2*SIN(CAMBER/2))
(*
 X5=RADIUSM*SIN(CAMBER/2)
 Y5=RADIUSM*COS(CAMBER/2)
(*
 X4=-X5
 Y4=Y5
(*
 X2=X1
 Y2=Y1+(THICK/2)
(*
 X3=X1
 Y3=Y1-(THICK/2)
```

```
(*
 X6=X4
 Y6=Y4+(Y4*.015)
(*
 X7-X5
 Y7=Y5+(Y5*.015)
(*
(*********************************************************************
(*                                                                   *
(*                  - AIRFOIL POINT DEFINITIONS -                    *
(*                      DEFINE ESMOSS POINTS                         *
(*                                                                   *
(*   P1   CENTER POINT TO DEFINE THE CIRCULAR ARC                    *
(*   P2   CENTER POINT TO DEFINE INNER ARC                           *
(*   P3   CENTER POINT TO DEFINE OUTER ARC                           *
(*   P4,6 POINT TO DEFINE THE LEADING EDGE                           *
(*   P5,7 POINT TO DEFINE THE TRAILING EDGE                          *
(*                                                                   *
(*   P11-P17 TOP OF AIRFOIL CROSS-SECTION                            *
(*********************************************************************
(*
 SETMODEL (X4,0,0,X5,RADIUSM+THICK,HEIGHT)
(*
(*      DEFINE BOTTOM OF AIRFOIL
(*
 POINT (1,0,0,0)
 POINT (2,X2,Y2,0)
 POINT (3,X3,Y3,0)
 POINT (4,X4,Y4,0)
 POINT (5,X5,Y5,0)
 POINT (6,X6,Y6,0)
 POINT (7,X7,Y7,0)
(*
(*      DEFINE TOP OF AIRFOIL
(*
 POINT (11,OFFSET,0,HEIGHT)
 POINT (12,X2+OFFSET,Y2,HEIGHT)
 POINT (13,X3+OFFSET,Y3,HEIGHT)
 POINT (14,X4+OFFSET,Y4,HEIGHT)
 POINT (15,X5+OFFSET,Y5,HEIGHT)
 POINT (16,X6+OFFSET,Y6,HEIGHT)
 POINT (17,X7+OFFSET,Y7,HEIGHT)
(*
(*                  DEFINE ESMOSS CURVES
(*
(*    BOTTOM OF AIRFOIL
(*
 ARC (1,3,4,5)
 ARC (2,2,6,7)
 LINE (3,4,6)
 LINE (4,5,7)
(*
(*     TOP OF AIRFOIL
```

```
(*
  ARC   (11,13,14,15)
  ARC   (12,13,16,17)
  LINE  (13,14,16)
  LINE  (14,15,17)
(*
(*       CONNECT TOP AND BOTTOM
(*
  LINE (21,4,14)
  LINE (22,5,15)
  LINE (23,6,16)
  LINE (24,7,17)
(*
(*                   DEFINE ESMOSS SURFACES
(*
  RULEDSRF (1,1,2)
  RULEDSRF (2,11,12)
  RULEDSRF (3,1,11)
  RULEDSRF (4,2,12)
  RULEDSRF (5,3,13)
  RULEDSRF (6,4,14)
(*
(*                   DEFINE ESMOSS REGIONS
(*
  REG3D   (1, 1, 2, 3, 4, 5, 6, &
              1, 2, 3, 4, 11, 12, 13, 14, 21, 22, 23, 24, &
              4, 5, 6, 7, 14, 15, 16, 17)
(*
(*
  PRINT INPUT THE NUMBER OF NODES ALONG THE PRESSURE SIDE
(* READ PNODE
  PNODE=3
(*
  PRINT INPUT THE NUMBER OF NODES ALONG THE LEADING EDGE
(* READ LNODE
  LNODE=2
(*
  PRINT INPUT THE NUMBER OF NODES ALONG THE AXIS
(* READ ANODE
  ANODE=2
(*
  DIS8NBRK (1)
  DISEDGE (1,PNODE)
  DISEDGE (3,LNODE)
  DISEDGE (13,ANODE)
  ENDISCRT
(*
  END RECIPE
```

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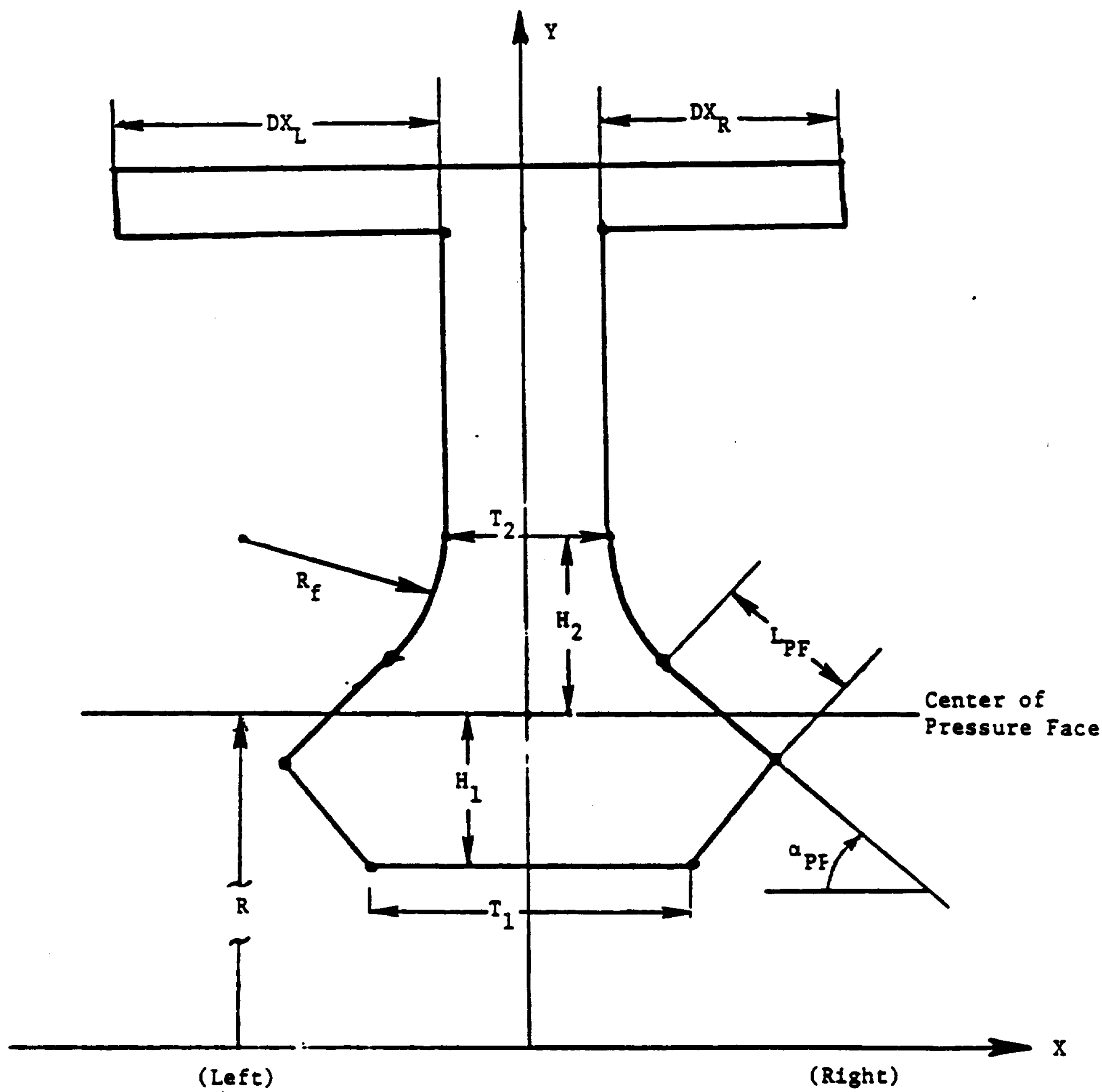
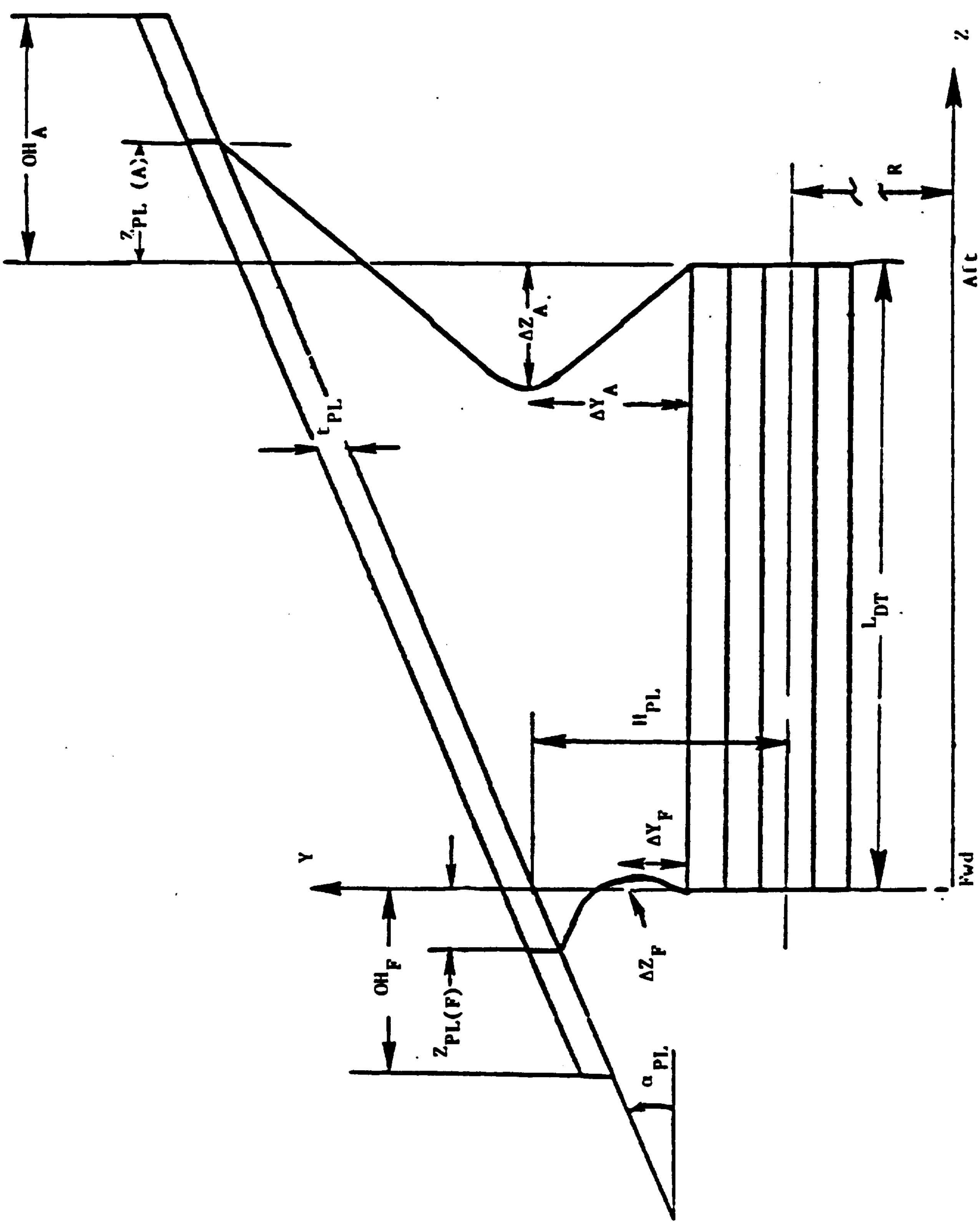
Dovetail-Platform - Parametric Model



Dovetail-Platform - Parametric Model

R	RADIUS TO CENTER OF PRESSURE FACE
L_{PF}	LENGTH OF PRESSURE FACE
α_{PF}	ANGLE OF PRESSURE FACE
H_1	DISTANCE TO DOVETAIL BOTTOM
T_1	THICKNESS AT DOVETAIL BOTTOM
H_2	DISTANCE TO MIN NECK
T_2	THICKNESS AT MIN NECK
R_F	FILLET RADIUS FROM PRESSURE FACE TO MIN NECK
DX_R	PLATFORM WIDTH (RIGHT)
DX_L	PLATFORM WIDTH (LEFT)

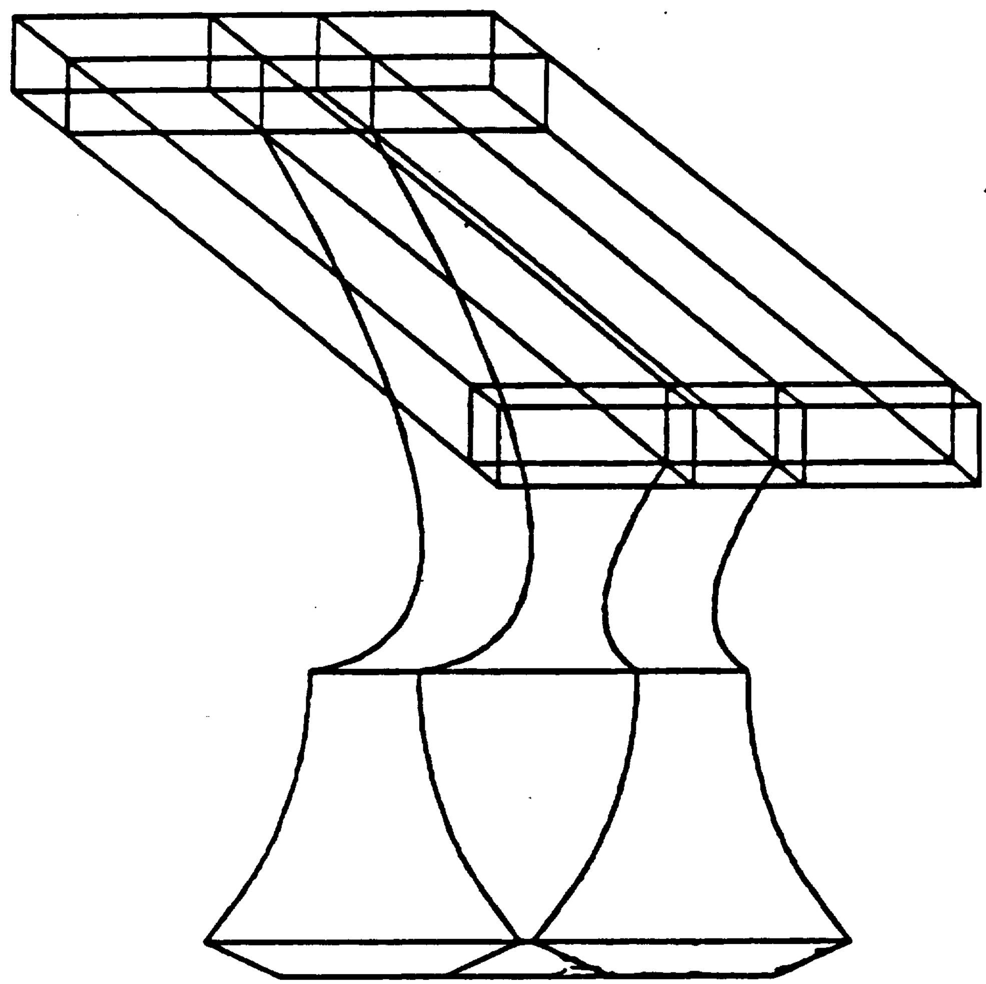
Dovetail-Platform - Parametric Model



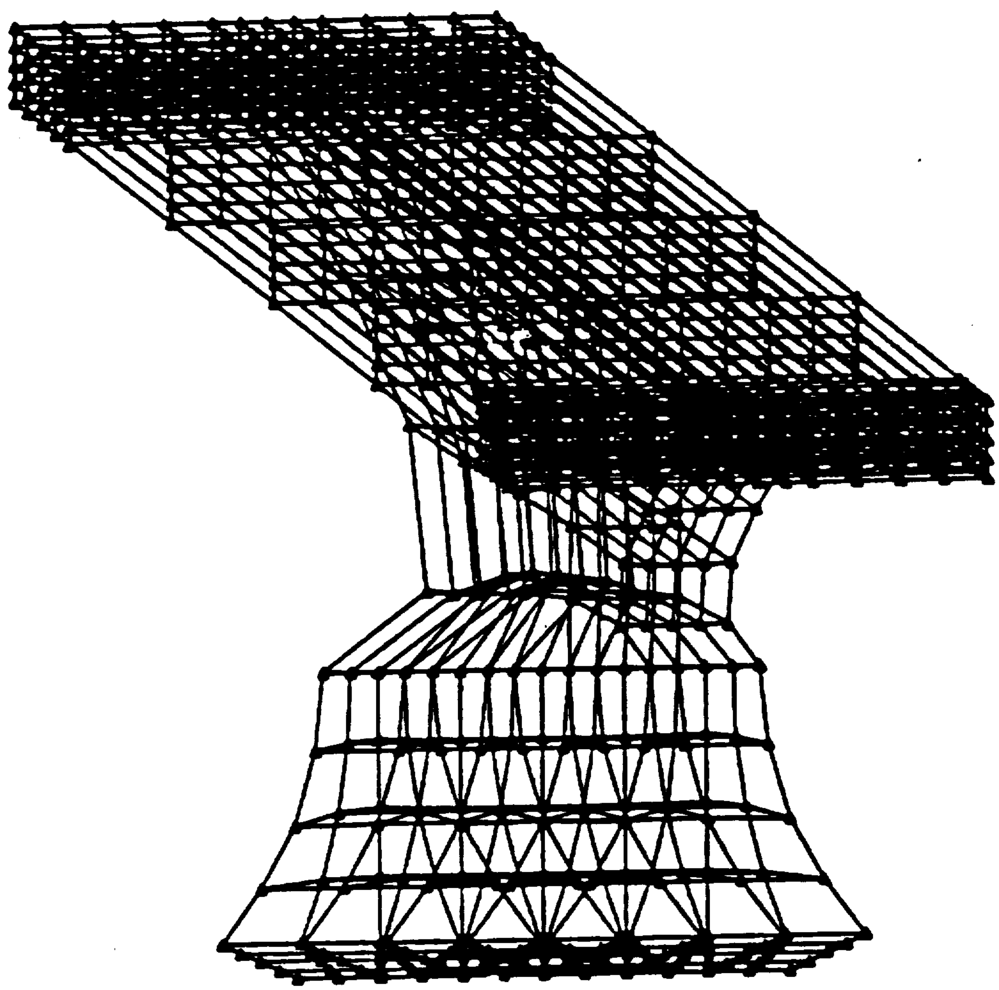
Dovetail-Platform - Parametric Model

T_{PL}	THICKNESS OF PLATFORM
H_{PL}	HEIGHT OF PLATFORM AT Z=0.
α_{PL}	ANGLE OF PLATFORM
OH_F	PLATFORM OVERHANG (FWD)
OH_A	PLATFORM OVERHANG (AFT)
L_{DT}	LENGTH OF DOVETAIL (AXIAL)
$Z_{PL(F)}$	OFFSET FOR FORWARD PLATFORM DOVETAIL INTERSECTION
$Z_{PL(A)}$	OFFSET FOR AFT PLATFORM DOVETAIL INTERSECTION
ΔY_A	AXIAL OFFSET FOR AFT DOVETAIL CUTOUT
ΔZ_A	RADIAL OFFSET FOR AFT DOVETAIL CUTOUT
ΔY_F	AXIAL OFFSET FOR FORWARD DOVETAIL CUTOUT
ΔZ_F	RADIAL OFFSET FOR FORWARD DOVETAIL CUTOUT

Dovetail-Platform - Geometric Model



Dovetail-Platform - Discrete Model



```
('
'             DOVETAIL RECIPE
('
('       -- DOVETAIL INPUT DATA --
('
('   PARAMETERS BASED ON DOVETAIL CROSS SECTION
('
PRINT RADIUS TO CENTER OF PRESSURE FACE =
('READ CTRFAC
CTRFAC=5
('
PRINT LENGTH OF PRESSURE FACE =
('READ RLNFAC
RLNFAC=1
('
PRINT ANGLE OF PRESSURE FACE (IN DEGREES) =
('READ ANGFAC
ANGFAC=45
ANGFAC = RADIAN(ANGFAC)
('
PRINT DISTANCE TO DOVETAIL BOTTOM =
('READ DISBTM
DISBTM=2
('
PRINT THICKNESS AT DOVETAIL BOTTOM =
('READ THKBTM
THKBTM=3
('
PRINT DISTANCE TO MIN NECK =
('READ DISNEK
DISNEK=2
('
PRINT THICKNESS AT MIN NECK =
('READ THKNEK
THKNEK=2
('
PRINT FILLET RADIUS FROM PRESSURE FACE TO MIN NECK =
('READ FILRAD
FILRAD=4
('
PRINT PLATFORM WIDTH (RIGHT)
('READ PLTWDR
PLTWDR=3.2
('
PRINT PLATFORM WIDTH (LEFT) =
('READ PLTWDL
PLTWDL=3.6
('
('   PARAMETERS BASED ON DOVETAIL 'CENTERLINE' VIEW
('
PRINT THICKNESS OF PLATFORM =
('READ THKPLT
```

```
THKPLT=1
(*
PRINT HEIGHT OF PLATFORM AT (Z=0) =
(*READ HTPLT0
HTPLT0=5
(*
PRINT ANGLE OF PLATFORM (IN DEGREES) =
(*READ ANGPLT
ANGPLT=0
ANGPLT = RADIAN(ANGPLT)
(*
PRINT PLATFORM OVERHANG (FORWARD) =
(*READ PLTOVF
PLTOVF=1
(*
PRINT PLATFORM OVERHANG (AFT) =
(*READ PLTOVA
PLTOVA=2
(*
PRINT LENGTH OF DOVETAIL (AXIAL) =
(*READ DOVAXL
DOVAXL=6
(*
PRINT OFFSET FOR FORWARD PLATFORM/DOVETAIL INTERSECTION =
(*READ FWDOFF
FWDOFF=.5
(*
PRINT AXIAL OFFSET FOR FORWARD DOVETAIL CUTOUT =
(*READ AXFCUT
AXFCUT=1
(*
PRINT RADIAL OFFSET FOR FORWARD DOVETAIL CUTOUT =
(*READ RDFCUT
RDFCUT=1
(*
PRINT OFFSET FOR AFT PLATFORM/DOVETAIL INTERSECTION =
(*READ AFTOFF
AFTOFF=1
(*
PRINT AXIAL OFFSET FOR AFT DOVETAIL CUTOUT =
(*READ AXACUT
AXACUT=2
(*
PRINT RADIAL OFFSET FOR AFT DOVETAIL CUTOUT =
(*READ RDACUT
RDACUT=1
(*
(*
(*    -- DOVETAIL POINT DEFINITIONS --
(*
  X1 = THKBTM/2
  Y1 = CTRFAC - DISBTM
(*
```

```
  X4 = THKNEK/2
  Y4 = CTRFAC + DISNEK
(*
  X3 = (X4 + FILRAD) - (FILRAD * SIN(ANGFAC))
  Y3 = Y4 - (FILRAD * COS(ANGFAC))
(*
  X2 = X3 + (RLNFAC * COS(ANGFAC))
  Y2 = Y3 - (RLNFAC * SIN(ANGFAC))
(*
  Y22 = CTRFAC + HTPLT0 + ((DOVAXL + AFTOFF) * TAN(ANGPLT))
  Z22 = DOVAXL + AFTOFF
(*
  X50 = PLTWDR + X4
  Y50 = Y22 + ((PLTOVA -AFTOFF) * TAN(ANGPLT))
  Z50 = Z22 + (PLTOVA - AFTOFF)
(*
(*     SET MODEL MINIMUM AND MAXIMUM
(*
  SETMODEL (-X4-PLTWDL, Y1, -PLTOVF, X4+PLTWDR, Y50+THKPLT, Z50)
(*
(*                                               BASE FRONT RIGHT
  POINT (1, X1, Y1, 0)
  POINT (2, X2, Y2, 0)
  POINT (3, X3, Y3, 0)
  POINT (4, X4, Y4, 0)
(*                                               BASE FRONT LEFT
  POINT (5,-X1, Y1, 0)
  POINT (6,-X2, Y2, 0)
  POINT (7,-X3, Y3, 0)
  POINT (8,-X4, Y4, 0)
(*                                               BASE BACK RIGHT
  POINT (9, X1, Y1, DOVAXL)
  POINT (10, X2, Y2, DOVAXL)
  POINT (11, X3, Y3, DOVAXL)
  POINT (12, X4, Y4, DOVAXL)
(*                                               BASE BACK LEFT
  POINT (13,-X1, Y1, DOVAXL)
  POINT (14,-X2, Y2, DOVAXL)
  POINT (15,-X3, Y3, DOVAXL)
  POINT (16,-X4, Y4, DOVAXL)
(*                                               CUTOUT FRONT RIGHT
  Y17 = Y4 + AXFCUT
  Y18 = CTRFAC + HTPLT0 - (FWDOFF * TAN(ANGPLT))
  POINT (17, X4, Y17, RDFCUT)
  POINT (18, X4, Y18,-FWDOFF)
(*                                               CUTOUT FRONT LEFT
  POINT (19,-X4, Y17, RDFCUT)
  POINT (20,-X4, Y18,-FWDOFF)
(*                                               CUTOUT BACK RIGHT
  Y21 = Y4 + AXACUT
  Z21 = DOVAXL - RDACUT
  POINT (21, X4, Y21, Z21)
  POINT (22, X4, Y22, Z22)
```

```
(*                                                    CUTOUT BACK LEFT
  POINT (23,-X4, Y21, Z21)
  POINT (24,-X4, Y22, Z22)
(*                                                    ARC CENTERS FRONT
  X25 = X4 + FILRAD
  POINT (25, X25, Y4, 0)
  POINT (26,-X25, Y4, 0)
(*                                                    ARC CENTERS BACK
  POINT (27, X25, Y4, DOVAXL)
  POINT (28,-X25, Y4, DOVAXL)
(*                                                    DOVETAIL PLATFORM
  POINT (50, X50, Y50, Z50)
(*
  X51 = -PLTWDL - X4
  Y52 = Y18 - ((PLTOVF - FWDOFF) * TAN (ANGPLT))
  Z52 = -PLTOVF
  POINT (51, X51, Y50, Z50)
  POINT (52, X50, Y52, Z52)
  POINT (53, X51, Y52, Z52)
(*                                                    BACK OF PLATFORM
  Y54 = Y50 + THKPLT
  Y56 = Y52 + THKPLT
  POINT (54, X50, Y54, Z50)
  POINT (55, X51, Y54, Z50)
  POINT (56, X50, Y56, Z52)
  POINT (57, X51, Y56, Z52)
(*                                                    INTERIOR PLATFORM POINTS
  POINT (60, X4, Y50, Z50)
  POINT (61,-X4, Y50, Z50)
  POINT (62,X51, Y22, Z22)
  POINT (63,X51, Y18, -FWDOFF)
  POINT (64,-X4, Y52, Z52)
  POINT (65, X4, Y52, Z52)
  POINT (66,X50, Y18, -FWDOFF)
  POINT (67,X50, Y22, Z22)
(*
  Y72 = Y22 + THKPLT
  Y73 = Y18 + THKPLT
(*
  POINT (70, X4, Y54, Z50)
  POINT (71,-X4, Y54, Z50)
  POINT (72,X51, Y72, Z22)
  POINT (73,X51, Y73, -FWDOFF)
  POINT (74,-X4, Y56, Z52)
  POINT (75, X4, Y56, Z52)
  POINT (76,X50, Y73, -FWDOFF)
  POINT (77,X50, Y72, Z22)
  POINT (78, X4, Y72, Z22)
  POINT (79,-X4, Y72, Z22)
  POINT (80, X4, Y73, -FWDOFF)
  POINT (81,-X4, Y73, -FWDOFF)
(*
(*   -- DOVETAIL CURVE DEFINITIONS --
```

```
(*
(*                                              BASE FRONT RIGHT
  LINE      (1, 1, 2)
  LINE      (2, 2, 3)
  ARC       (3, 25, 3, 4)
  MRGCURVE  (4, 2, 3)
(*                                              BASE FRONT LEFT
  LINE      (5, 5, 6)
  LINE      (6, 6, 7)
  ARC       (7, 26, 7, 8)
  MRGCURVE  (8, 6, 7)
(*                                              CONNECT BASE FRONT
  LINE      (9, 1, 5)
  LINE      (10, 2, 6)
  LINE      (11, 4, 8)
(*                                              BASE BACK RIGHT
  LINE      (12, 9, 10)
  LINE      (13, 10, 11)
  ARC       (14, 27, 11, 12)
  MRGCURVE  (15, 13, 14)
(*                                              BASE BACK LEFT
  LINE      (16, 13, 14)
  LINE      (17, 14, 15)
  ARC       (18, 28, 15, 16)
  MRGCURVE  (19, 17, 18)
(*                                              CONNECT BASE BACK
  LINE      (20, 9, 13)
  LINE      (21, 10, 14)
  LINE      (22, 12, 16)
(*                                              CONNECT BASE RIGHT
  LINE      (23, 1, 9)
  LINE      (24, 2, 10)
  LINE      (25, 4, 12)
(*                                              CONNECT BASE LEFT
  LINE      (26, 5, 13)
  LINE      (27, 6, 14)
  LINE      (28, 8, 16)
(*                                              CUTOUT FRONT
  PARABOLA  (29, 17, 4, 18)
  PARABOLA  (30, 19, 8, 20)
(*                                              CUTOUT BACK
  PARABOLA  (31, 21, 12, 22)
  PARABOLA  (32, 23, 16, 24)
(*
(*    -- DOVETAIL / PLATFORM INTERFACE --
(*
(*                                              BOTTOM
  LINE      (33, 18, 20)
  LINE      (34, 22, 24)
  LINE      (35, 18, 22)
  LINE      (36, 20, 24)
(*
(*    -- DOVETAIL PLATFORM --
```

```
(*                                                  CONNECT OUTER PERIMETER
   LINE        (50, 50, 60)
   LINE        (51, 60, 61)
   LINE        (52, 61, 51)
   LINE        (53, 52, 65)
   LINE        (54, 65, 64)
   LINE        (55, 64, 53)
   LINE        (56, 53, 63)
   LINE        (57, 63, 62)
   LINE        (58, 62, 51)
   LINE        (59, 52, 66)
   LINE        (60, 66, 67)
   LINE        (61, 67, 50)
(*                                                  CONNECT PERIMETER TO INTERIOR
(*                                                  POINTS
   LINE        (62, 22, 60)
   LINE        (63, 24, 61)
   LINE        (64, 24, 62)
   LINE        (65, 20, 63)
   LINE        (66, 64, 20)
   LINE        (67, 65, 18)
   LINE        (68, 66, 18)
   LINE        (69, 67, 22)
(*                                                  CONNECT OUTER PERIMETER PTS
   LINE        (70, 54, 70)
   LINE        (71, 70, 71)
   LINE        (72, 71, 55)
   LINE        (73, 56, 75)
   LINE        (74, 75, 74)
   LINE        (75, 74, 57)
   LINE        (76, 57, 73)
   LINE        (77, 73, 72)
   LINE        (78, 72, 55)
   LINE        (79, 56, 76)
   LINE        (80, 76, 77)
   LINE        (81, 77, 54)
(*                                                  CONNECT BACK PERIMETER TO
(*                                                  INTERIOR POINTS
   LINE        (82, 78, 70)
   LINE        (83, 79, 71)
   LINE        (84, 79, 72)
   LINE        (85, 81, 73)
   LINE        (86, 74, 81)
   LINE        (87, 75, 80)
   LINE        (88, 76, 80)
   LINE        (89, 77, 78)
(*                                                  CONNECT FRONT TO BACK
   LINE        (90, 60, 70)
   LINE        (91, 61, 71)
   LINE        (92, 62, 72)
   LINE        (93, 63, 73)
   LINE        (94, 64, 74)
   LINE        (95, 65, 75)
```

```
  LINE      (96, 66, 76)
  LINE      (97, 67, 77)
  LINE      (98, 22, 78)
  LINE      (99  24, 79)
  LINE      (100, 18, 80)
  LINE      (101, 20, 81)
  LINE      (102, 78, 79)
  LINE      (103, 80, 81)
  LINE      (104, 80, 78)
  LINE      (105, 81, 79)
(*
  LINE      (110, 50, 54)
  LINE      (111, 51, 55)
  LINE      (112, 52, 56)
  LINE      (113, 53, 57)
(*
(*
(*      -- DOVETAIL SURFACES --
(*
(*                                        BASE BOTTOM
  RULEDSRF (1, 1, 5)
  RULEDSRF (2, 12, 16)
  RULEDSRF (3, 1, 12)
  RULEDSRF (4, 5, 16)
  RULEDSRF (5, 9, 20)
  RULEDSRF (6, 10, 21)
(*                                        BASE TOP
  RULEDSRF (7, 4, 8)
  RULEDSRF (8, 15, 19)
  RULEDSRF (9, 4, 15)
  RULEDSRF (10, 8, 19)
  RULEDSRF (11, 11, 22)
(*                                        CUTOUT
  RULEDSRF (12, 29, 30)
  RULEDSRF (13, 31, 32)
  RULEDSRF (14, 29, 31)
  RULEDSRF (15, 30, 32)
  RULEDSRF (16, 33, 34)
(*                                        PLATFORM LOWER LEFT
  RULEDSRF (20, 56, 76)
  RULEDSRF (21, 66, 86)
  RULEDSRF (22, 55, 75)
  RULEDSRF (23, 65, 85)
  RULEDSRF (24, 75, 85)
  RULEDSRF (25, 55, 65)
(*                                        PLATFORM LOWER MIDDLE
  RULEDSRF (26, 66, 67)
  RULEDSRF (27, 54, 74)
  RULEDSRF (28, 100,95)
  RULEDSRF (29, 86, 87)
  RULEDSRF (30, 33,103)
(*                                        PLATFORM LOWER RIGHT
  RULEDSRF (31, 59, 67)
```

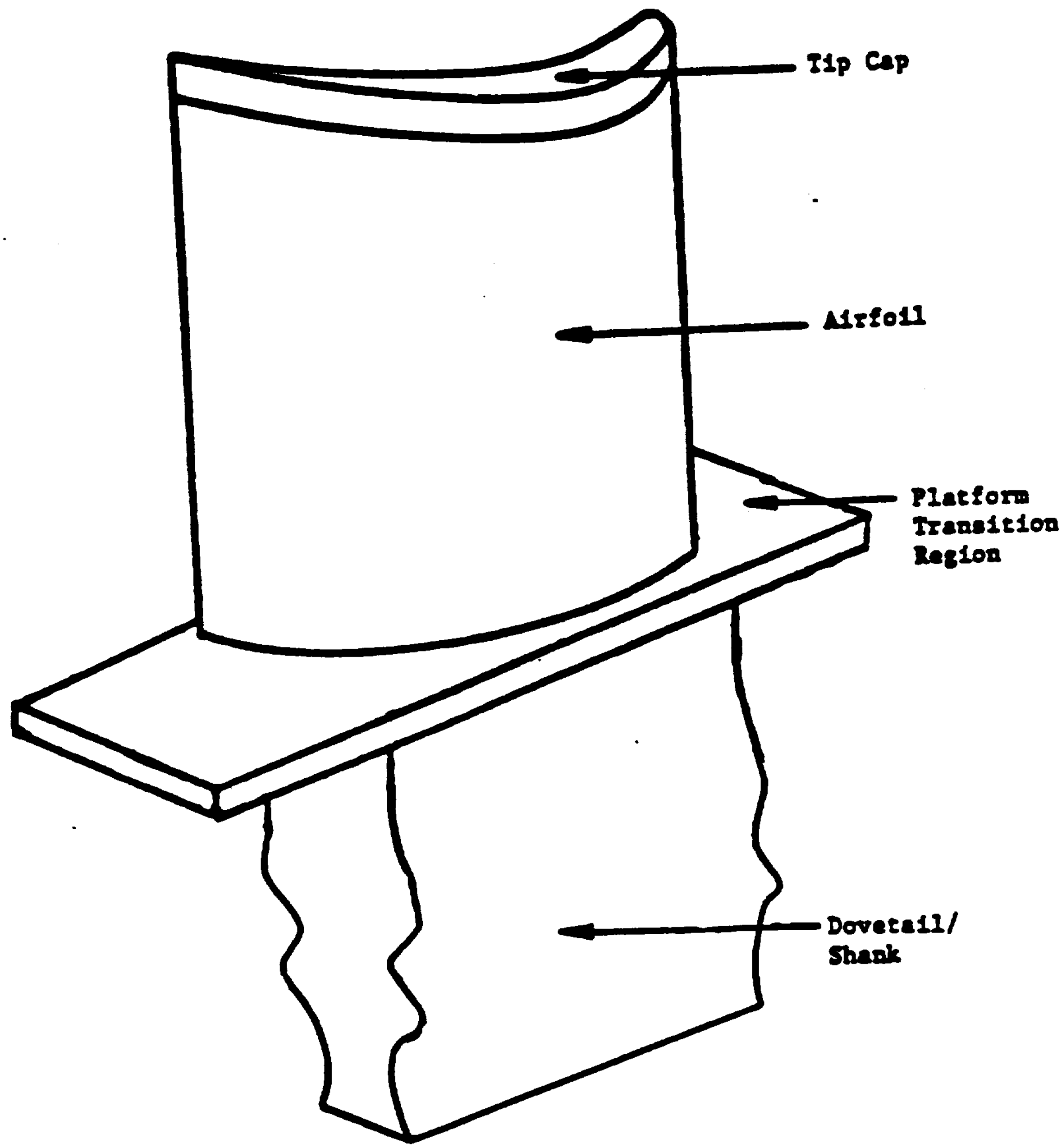
```
 RULEDSRF (32, 53, 73)
 RULEDSRF (33, 96,112)
 RULEDSRF (34, 73, 88)
 RULEDSRF (35, 68, 88)
(*                                    PLATFORM MIDDLE LEFT
 RULEDSRF (36, 57, 77)
 RULEDSRF (37, 57, 36)
 RULEDSRF (38, 77,105)
 RULEDSRF (39, 36,105)
 RULEDSRF (40, 64, 84)
(*                                    PLATFORM MIDDLE
 RULEDSRF (41, 35, 36)
 RULEDSRF (42,104,105)
 RULEDSRF (43, 98, 99)
(*                                    PLATFORM MIDDLE RIGHT
 RULEDSRF (46, 35,104)
 RULEDSRF (47, 35, 60)
 RULEDSRF (48, 60, 80)
 RULEDSRF (49, 69, 89)
 RULEDSRF (50, 80,104)
(*                                    PLATFORM UPPER LEFT
 RULEDSRF (51, 92,111)
 RULEDSRF (52, 99, 91)
 RULEDSRF (53, 64, 52)
 RULEDSRF (54, 52, 72)
 RULEDSRF (55, 72, 84)
(*                                    PLATFORM UPPER MIDDLE
 RULEDSRF (56, 98, 90)
 RULEDSRF (57, 99, 98)
 RULEDSRF (58, 90, 91)
 RULEDSRF (59, 62, 63)
 RULEDSRF (60, 82, 83)
(*                                    PLATFORM UPPER RIGHT
 RULEDSRF (61, 61, 81)
 RULEDSRF (62, 69, 89)
 RULEDSRF (63, 69, 50)
 RULEDSRF (64, 50, 70)
 RULEDSRF (65, 89, 70)
(*
(*    -- REGIONS --
(*
 REG3D (1, 1, 2, 3, 4, 5, 6, &
           1, 5, 9, 10, 12, 16, 20, 21, 23, 24, 26, 27, &
           1, 2, 5, 6, 9, 10, 13, 14)
(*
 REG3D (2, 6, 7, 8, 9, 10, 11, &
           4, 8, 10, 11, 15, 19, 21, 22, 24, 25, 27, 28, &
           2, 4, 6, 8, 10, 12, 14, 16)
(*
 REG3D (3, 11, 12, 13, 14, 15, 16, &
           11, 29, 30, 33, 22, 31, 32, 34, 25, 35, 28, 36, &
           4, 8, 18, 20, 12, 16, 22, 24)
(*
```

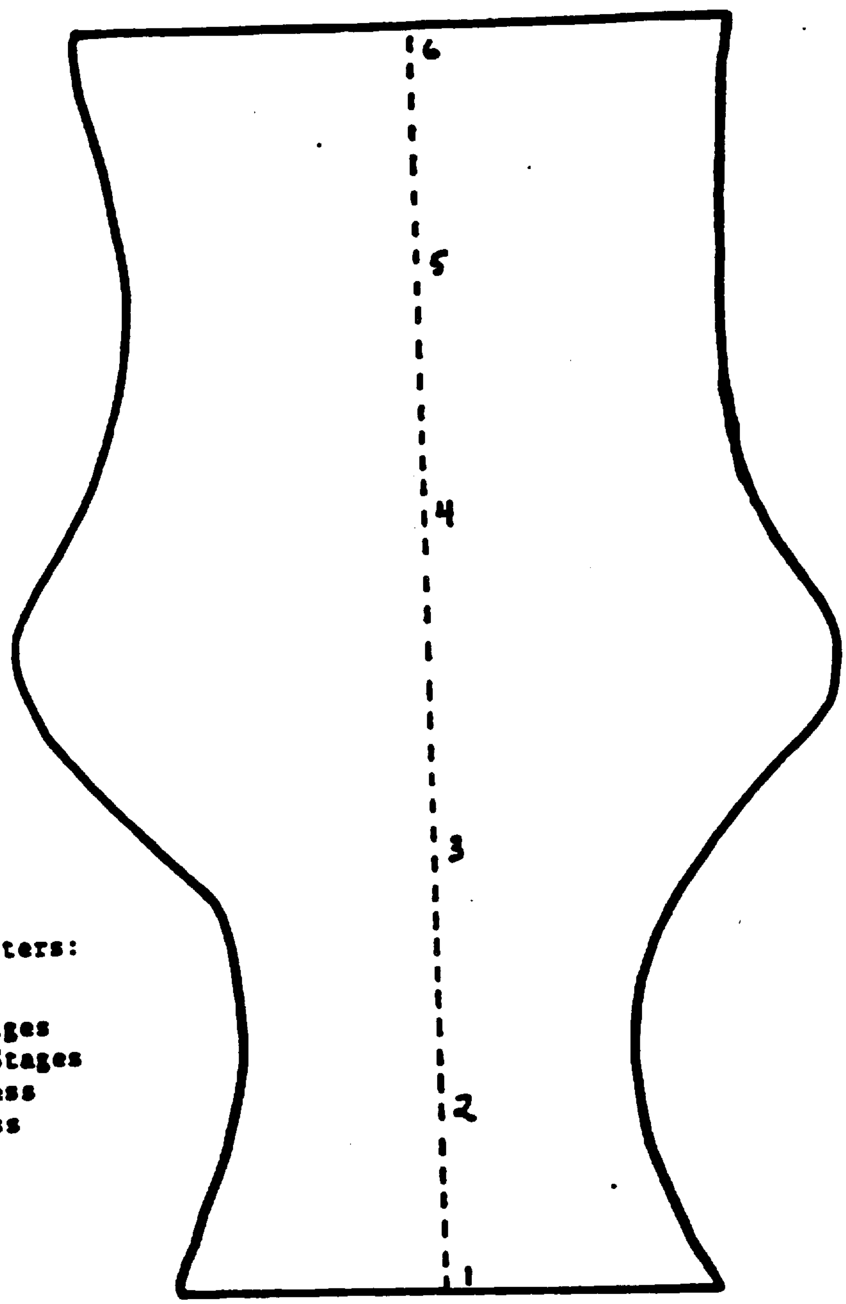
```
REG3D (4, 20, 21, 22, 23, 24, 25, &
          56, 76, 55, 75, 66, 86, [illegible], 113, 93, 101, 94, 85, &
          53, 57, 63, 73, 64, [illegible], 74, 81)
(*
 REG3D (5, 21, 26, 27, 28, 29, 30, &
          66, 67, 54, 33, 86, 101, 100, 95, 87, 103, 74, 94, &
          64, 65, 20, 18, 80, 81, 74, 75)
(*
 REG3D (6, 28, 31, 32, 33, 34, 35, &
          95, 100, 67, 87, 53, 68, 59, 73, 112, 96, 88, 79, &
          65, 75, 18, 80, 52, 56, 66, 76)
(*
 REG3D (7, 23, 36, 37, 38, 39, 40, &
          65, 85, 101, 93, 57, 77, 92, 105, 36, 64, 84, 99, &
          63, 73, 20, 81, 62, 72, 24, 79)
(*
 REG3D (8, 30, 39, 46, 41, 42, 43, &
          33, 103, 101, 100, 36, 105, 99, 35, 104, 98, 34, 102, &
          20, 81, 18, 80, 24, 79, 22, 78)
(*
 REG3D (9, 35, 46, 47, 48, 49, 50, &
          68, 88, 96, 100, 35, 104, 98, 60, 80, 97, 69, 89, &
          18, 80, 66, 76, 22, 78, 67, 77)
(*
 REG3D (10,40, 51, 52, 53, 54, 55, &
          64, 84, 92, 99, 111, 91, 52, 58, 78, 63, 83, 72, &
          62, 72, 24, 79, 51, 55, 61, 71)
(*
 REG3D (11,52, 56, 57, 58, 59, 60, &
          99, 91, 63, 83, 98, 90, 82, 62, 34, 102, 51, 71, &
          22, 24, 78, 79, 60, 61, 70, 71)
(*
 REG3D (12,56, 61, 62, 63, 64, 65, &
          90, 98, 62, 82, 61, 81, 50, 89, 70, 69, 97, 110, &
          22, 67, 77, 78, 60, 70, 50, 54)
(*
 PRINT INPUT THE NUMBER OF NODES PER EDGE FOR THE DOVETAIL/SHANK
(* READ DNODE
 DNODE=3
(*
 DIS8NBRK (1)
 DISEDGE (1,DNODE)
 DISEDGE (9,DNODE)
 DISEDGE (23,DNODE)
 ENDISCRT
(*
 DIS8NBRK (2)
 DISEDGE (8,DNODE)
 DISEDGE (24,DNODE)
 DISEDGE (27,DNODE)
 ENDISCRT
(*
 DIS8NBRK (3)
```

```
   DISEDGE (29.DNODE)
   DISEDGE (33.DNODE)
   DISEDGE (36.DNODE)
   ENDISCRT
(*
   DIS8NBRK (4)
   DISEDGE (56.DNODE)
   DISEDGE (93.DNODE)
   DISEDGE (55.DNODE)
   ENDISCRT
(*
   DIS8NBRK (5)
   DISEDGE (66.DNODE)
   DISEDGE (95.DNODE)
   DISEDGE (74.DNODE)
   ENDISCRT
(*
   DIS8NBRK (6)
   DISEDGE (59,DNODE)
   DISEDGE (96,DNODE)
   DISEDGE (68,DNODE)
   ENDISCRT
(*
   DIS8NBRK (7)
   DISEDGE (57,DNODE)
   DISEDGE (65,DNODE)
   DISEDGE (77,DNODE)
   ENDISCRT
(*
   DIS8NBRK (8)
   DISEDGE (35,DNODE)
   DISEDGE (99.DNODE)
   DISEDGE (104.DNODE)
   ENDISCRT
(*
   DIS8NBRK (9)
   DISEDGE (60,DNODE)
   DISEDGE (69,DNODE)
   DISEDGE (97,DNODE)
   ENDISCRT
(*
   DIS8NBRK (10)
   DISEDGE (92,DNODE)
   DISEDGE (63,DNODE)
   DISEDGE (78,DNODE)
   ENDISCRT
(*
   DIS8NBRK (11)
   DISEDGE (99,DNODE)
   DISEDGE (63,DNODE)
   DISEDGE (51,DNODE)
   ENDISCRT
(*
```

```
  DIS8NBRK (12)
  DISEDGE (69,DNODE)
  DISEDGE (62,DNODE)
  DISEDGE (98,DNODE)
  ENDISCRT
(*
END RECIPE
```

Air-Cooled Turbine Blade - Modeling Regions

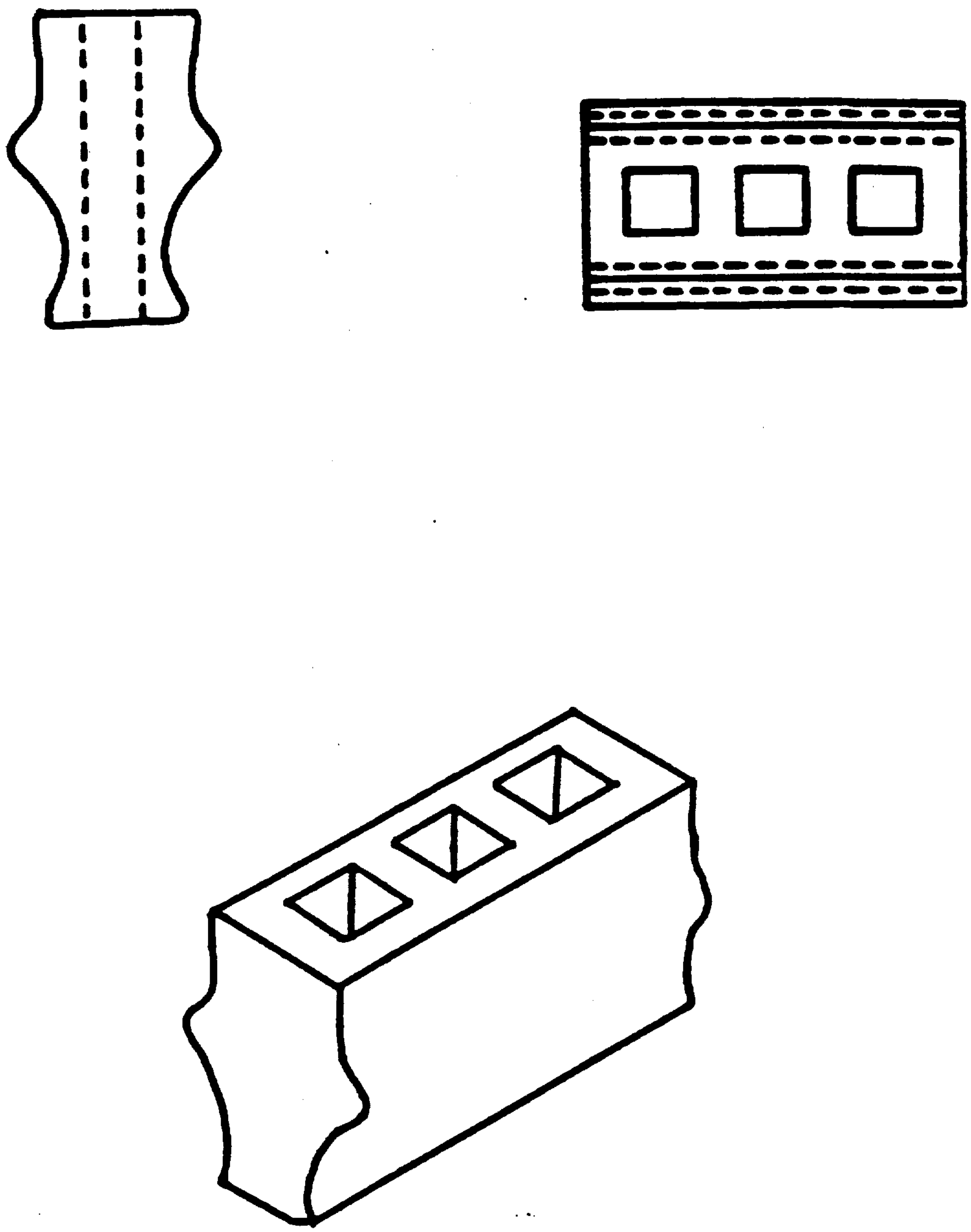




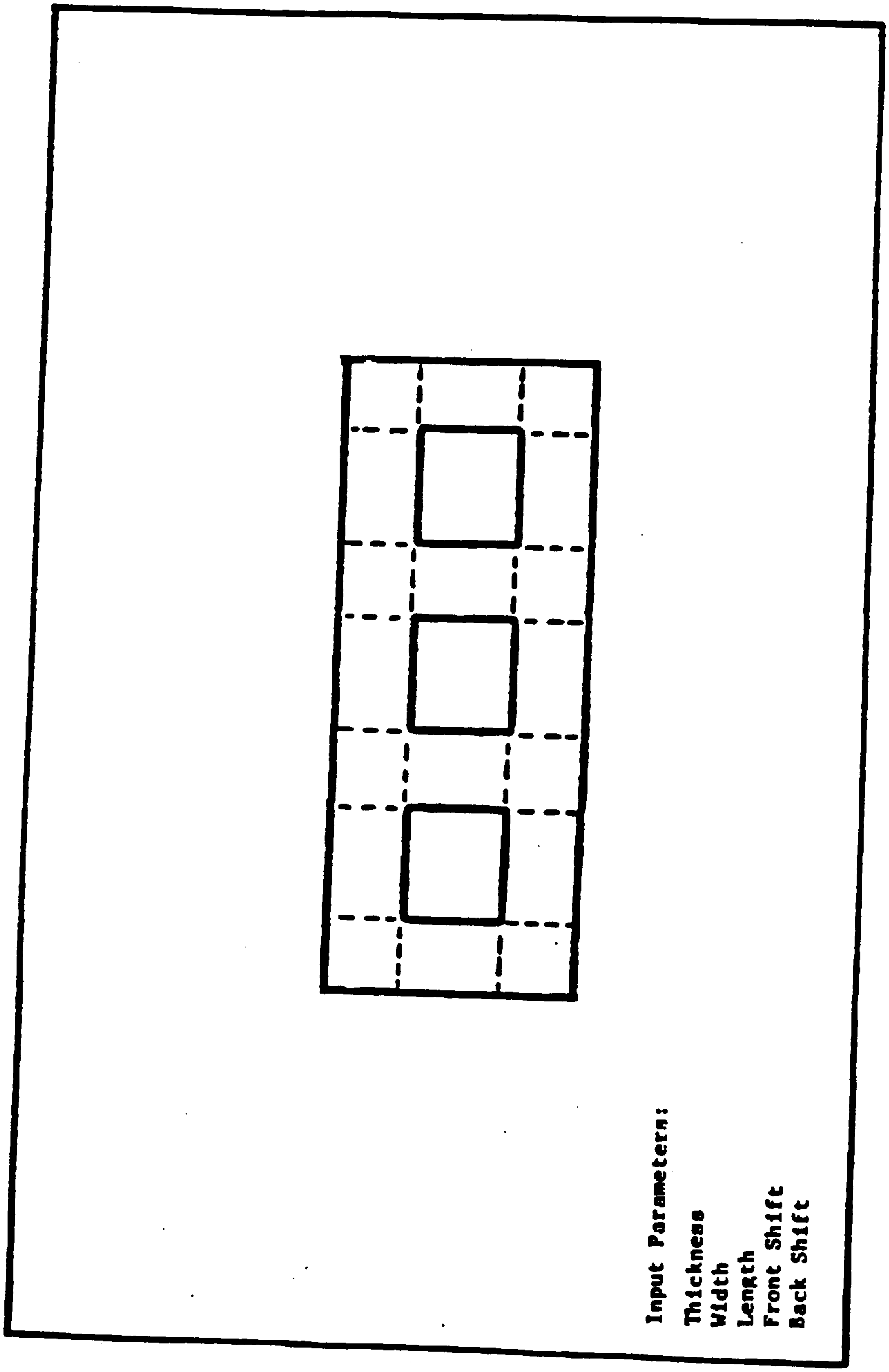
Input Parameters:

Thikness
Width at Stages
Arc Radius Stages
Wall Thickness
Rib Thickness

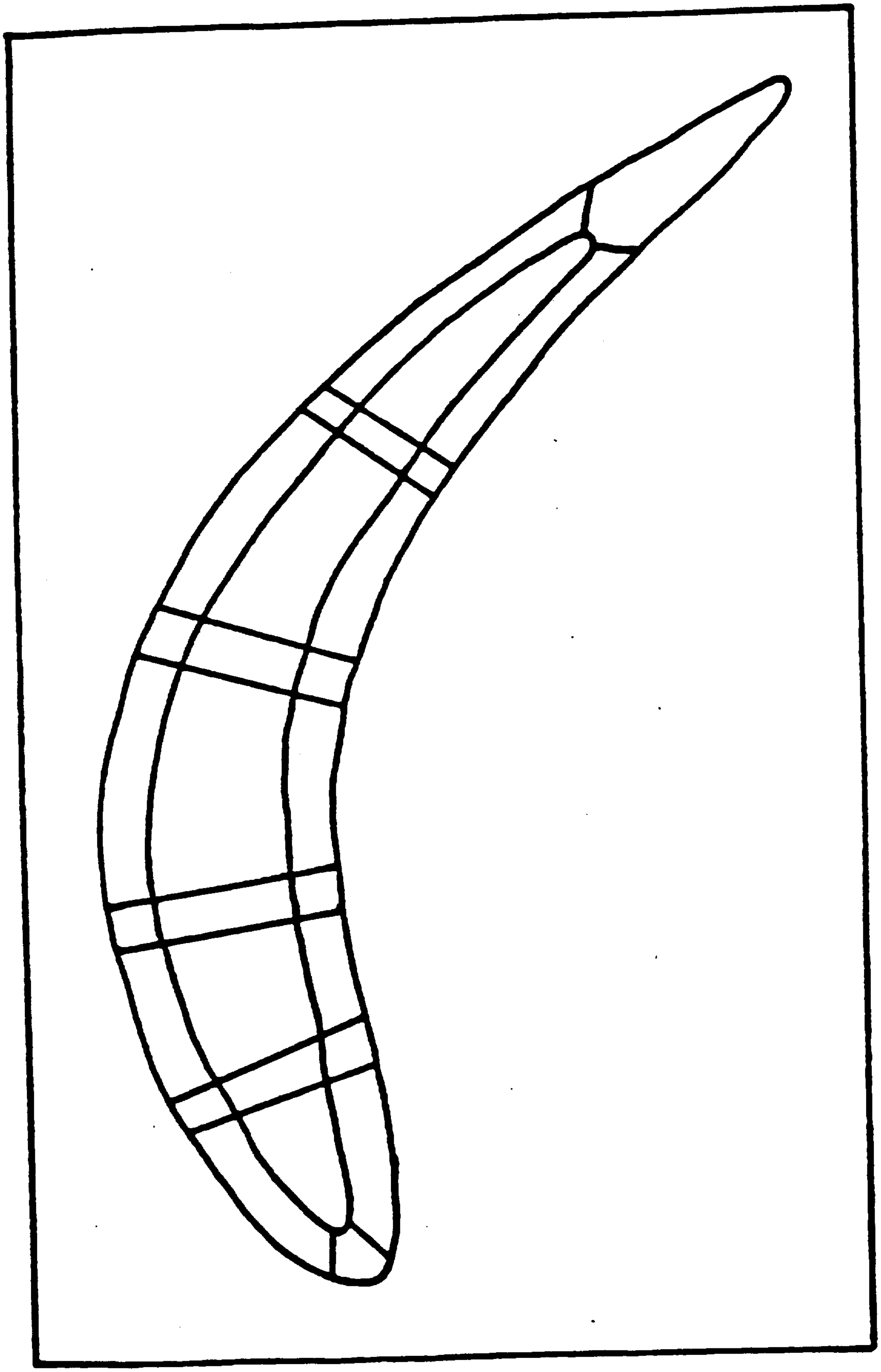
Air-Cooled Turbine Blade - Dovetail



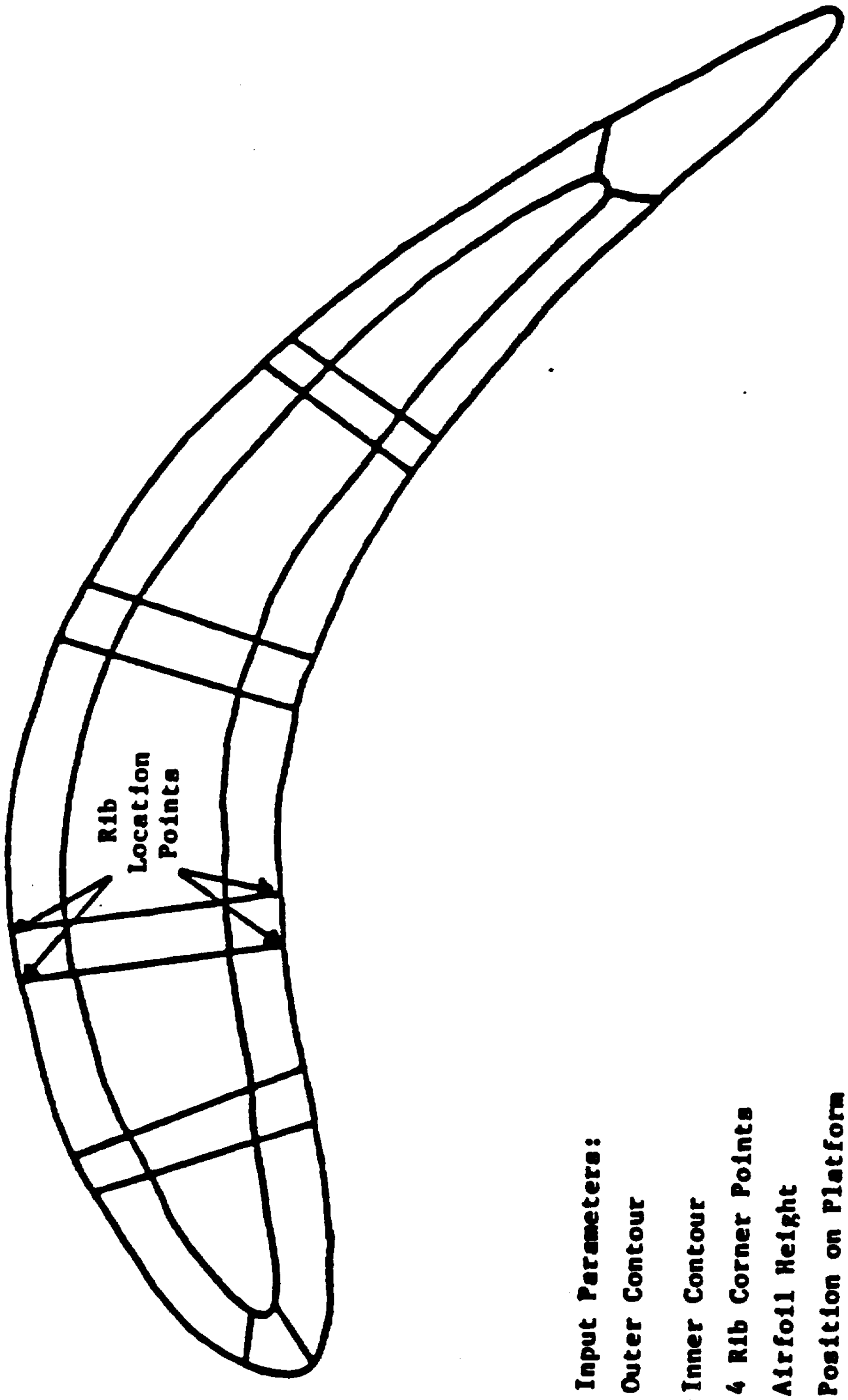
Air-Cooled Turbine Blade - Platform (bottom)



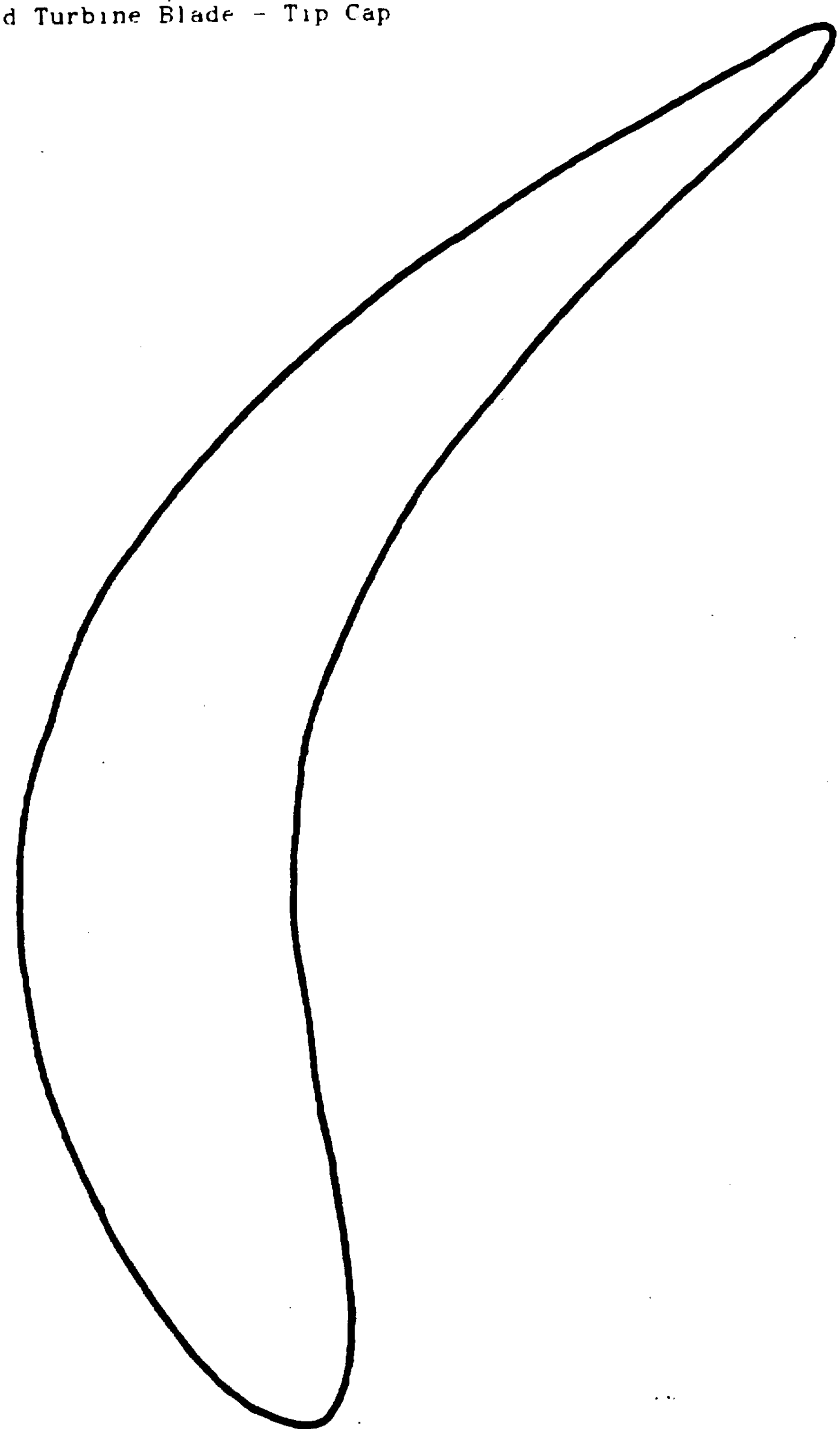
Air-Cooled Turbine Blade - Platform (top)



Air-Cooled Turbine Blade - Airfoil

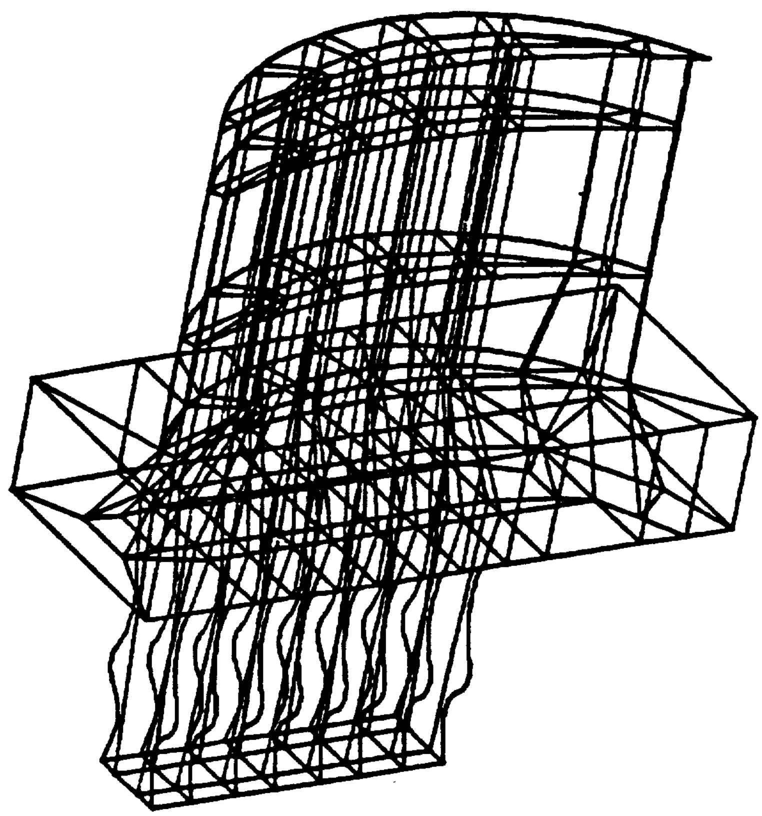


Air-Cooled Turbine Blade - Tip Cap

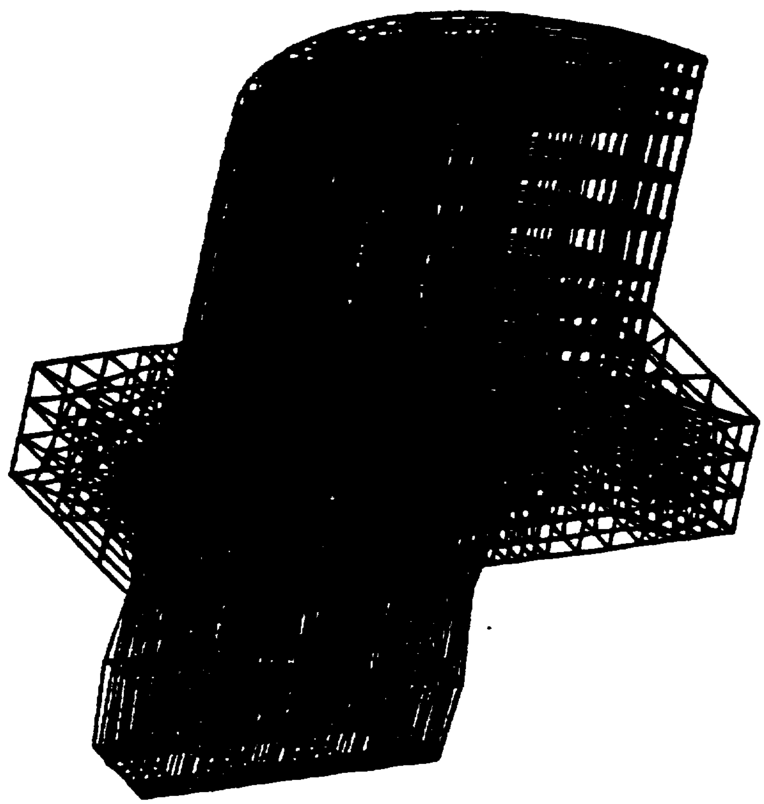


Input Parameters:
Thickness

Air-Cooled Turbine Blade - Geometric Model



Air-Cooled Turbine Blade - Discrete Model



```
(*
(*              AIR COOLED TURBINE BLADE RECIPE
(*
(*                 -- DOVETAIL INPUT DATA  --
(*                     -  USER PROMPTS  -
(*
(*><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*
(*                      DEFINE THE DOVETAIL
(*
(*><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*
PRINT
PRINT !!! DEFINE THE DOVETAIL/SHANK !!!
PRINT
PRINT INPUT THE LENGTH OF THE SHANK
(*READ STHICK
  STHICK = 7.5
(*
PRINT INPUT COOLING HOLE WALL THICKNESS
(*READ WTHICK
  WTHICK = .6
(*
PRINT INPUT COOLING HOLE RIB THICKNESS
(*READ RTHICK
  RTHICK = 1
(*
(* COMPUTE WIDTH OF COOLING HOLES
   HOLE = (STHICK-(4*RTHICK))/3
(*
PRINT
PRINT !!!  DEFINE THE DOVETAIL/SHANK SECTION !!!
PRINT THERE ARE 8 INPUT POINTS USED TO DEFINE THE DOVETAIL CROSS-SECTION
PRINT POINT 1 DEFINES THE BOTTOM OF THE DOVETAIL
PRINT POINT 7 DEFINES THE SHAPE AT THE TOP EDGE OF THE SHANK
PRINT THE RADIUS OF EACH POINT IS MEASURED FROM THE BOTTTOM OF THE
PRINT DOVETAIL
PRINT THE THICKNESS IS MEASURED FROM THE CENTER-LINE POINT TO THE SIDE
PRINT OF THE DOVETAIL
PRINT THE ARC RADIUS DETERMINES THE CURVATURE OF THE DOVETAIL
PRINT IF ARC RADIUS = 0, CONNECT BY STRAIGHT LINE FROM THE PRIOR POINT
PRINT IF ARC RADIUS < 0, CONNECT BY CIRCULAR ARC WITH INTERIOR CENTER
PRINT POINT
PRINT IF ARC RADIUS > 0, CONNECT BY CIRCULAR ARC WITH EXTERIOR CENTER
PRINT POINT
PRINT
PRINT INPUT FIRST DOVETAIL POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ DRADIUS1
(*READ DTHICK1
(*READ ARC1
```

```
  DRADIUS1=1
  DTHICK1=1.1
  ARC1=0
(*
PRINT INPUT SECOND DOVETAIL POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ DRADIUS2
(*READ DTHICK2
(*READ ARC2
  DRADIUS2=2
  DTHICK2=.8
  ARC2=0
(*
PRINT INPUT THIRD DOVETAIL POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ DRADIUS3
(*READ DTHICK3
(*READ ARC3
  DRADIUS3=3
  DTHICK3=1.2
  ARC3=1
(*
PRINT INPUT FOURTH DOVETAIL POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ DRADIUS4
(*READ DTHICK4
(*READ ARC4
  DRADIUS4=4
  DTHICK4=1.3
  ARC4=-.75
(*
PRINT INPUT FIFTH DOVETAIL POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ DRADIUS5
(*READ DTHICK5
(*READ ARC5
  DRADIUS5=6.5
  DTHICK5=1.2
  ARC5=3
(*
PRINT INPUT SIXTH DOVETAIL POINT - RADIUS, THICKNESS, ARC RADIUS
(*READ DRADIUS6
(*READ DTHICK6
(*READ ARC6
  DRADIUS6=8
  DTHICK6=1.5
  ARC6=0
(*
(*******************************************************************
(*
  PRINT
  PRINT   !!!  DEFINE THE PLATFORM SECTION  !!!
  PRINT
  PRINT INPUT THE PLATFORM HEIGHT
(*READ PTHICK
  PTHICK=3
  PRINT INPUT THE PLATFORM WIDTH
```

```
(*READ PWIDTH
 PWIDTH=6
 PRINT INPUT THE PLATFORM LENGTH
(*READ PLENGTH
 PLENGTH=15
 PRINT INPUT THE PRESSURE SIDE SHIFT FROM THE CENTERED POSITION ON
 PRINT THE SHANK
(*READ FRTSHFT
 FRTSHFT=.5
 PRINT INPUT THE TRAILING EDGE SHIFT FROM THE CENTERED POSITION ON
 PRINT THE SHANK
(*READ SIDSHFT
 SIDSHFT=1.0
(*
(*
(*************************************************************
(*
(*   DEFINE MACRO TO CALCULATE ARC CENTER POINT
(*
 DEFINE CNTR-PT
(*
 RKSQ=RK*RK
 XMK=XM-XK
 YMK=YM-YK
 DISTSQ=XMK*XMK +YMK*YMK
(*
 SUMRSQ=RKSQ*2
 ROOT=2*SUMRSQ*DISTSQ - DISTSQ*DISTSQ
 DSTINV=.5/DISTSQ
 SCL=.5
(*
 X=XMK*SCL +XK
 Y=YMK*SCL +YK
 ROOT=DSTINV*SQRT(ROOT)
(*
 XFAC=XMK*ROOT
 YFAC=YMK*ROOT
(*
(* THE 2 ROOTS OF THE EQUATIONS FOLLOW - 2 POINTS AND A RADIUS
(* DEFINE 2 POSSIBLE CENTER POINTS
(*
 XL=X+YFAC
 YL=Y-XFAC
 XR=X-YFAC
 YR=Y+XFAC
(*
 END CNTR-PT
(*
(*************************************************************
(*
(*
 RK=3
 XK=1
```

```
YK=1
XM=2
YM=2
CNTR-PT
X13=XL
Y13=YL
(*
(*
(**************************************************************
(*                                                            *
(*        - - DOVETAIL POINT DEFINITIONS  - -                 *
(*              DEFINE ESMOSS POINTS                          *
(*                                                            *
(*  P D1-D36 PERMANENT POINTS NEEDED TO DEFINE REGIONS        *
(*  P912 - 937  TEMPORARY POINTS NEEDED TO DEFINE CURVES      *
(*                                                            *
(**************************************************************
(*
   TIME = 1
   DOVE = 0
   LDOVE = 0
   YCORD = 0
(*
(*  WOVRHANG = WIDTH OVERHANG OF THE PLATFORM FROM THE SHANK
(*  LOVRHANG = LENGTH OVERHANG OF THE PLATFORM FROM THE SHANK
(*
 WOVRHANG=(PWIDTH-(DTHICK6*2))/2
 LOVRHANG=(PLENGTH-STHICK)/2
(*
 PTEMP1=-DTHICK6-WOVRHANG+FRTSHFT
 PTEMP2=-LOVRHANG+SIDSHFT
 PTEMP3=DTHICK+WOVRHANG+FRTSHFT
 PTEMP4=STHICK+LOVRHANG+SIDSHFT
(*
 PRINT AT WHAT 'Z' VALUE DO YOU WANT THE FIRST CROSS-SECTION AT?
(* READ ZVAL1
 ZVAL1=14
(*
 PRINT AT WHAT 'Z' VALUE DO YOU WANT THE TOP OF THE BLADE AT?
(* READ ZVAL2
 ZVAL2=18
(*
 PRINT AT WHAT 'Z' VALUE DO YOU WANT THE TIP CAP AT?
(* READ ZVAL3
 ZVAL3=20
(*
 SETMODEL (PTEMP1,PTEMP2,0,PTEMP3,PTEMP4,ZVAL3)
(*
   REPEAT
(*
   POINT (DOVE+1,DTHICK1,YCORD,DRADIUS1)
   POINT (912,DTHICK2,YCORD,DRADIUS2)
   POINT (913,DTHICK3,YCORD,DRADIUS3)
```

```
    POINT (914,DTHICK4,YCORD,DRADIUS4)
    POINT (917,DTHICK5,YCORD,DRADIUS5)
    POINT (DOVE+2,DTHICK6,YCORD,DRADIUS6)
(*
    POINT (DOVE+3,-DTHICK1,YCORD,DRADIUS1)
    POINT (918,-DTHICK2,YCORD,DRADIUS2)
    POINT (919,-DTHICK3,YCORD,DRADIUS3)
    POINT (920,-DTHICK4,YCORD,DRADIUS4)
    POINT (923,-DTHICK5,YCORD,DRADIUS5)
    POINT (DOVE+4,-DTHICK6,YCORD,DRADIUS6)
(*
    POINT (DOVE+33,-DTHICK1+WTHICK,YCORD,DRADIUS1)
    POINT (DOVE+34,-DTHICK6+WTHICK,YCORD,DRADIUS6)
    POINT (DOVE+35,DTHICK1-WTHICK,YCORD,DRADIUS1)
    POINT (DOVE+36,DTHICK6-WTHICK,YCORD,DRADIUS6)
(*
(*              DEFINE CENTER POINTS FOR CURVES
(*
(*  DEFINE POINTS TO CONNECT FIRST AND SECOND POINTS IF NECESSARY
(*  IF ARC2= 0. THEN CONNECT POINTS BY LINES
(*              ELSE CONNECT POINTS BY ARCS
(*
  IF (ARC2 = 0)
  THEN
    LINE (101,DOVE+1,912)
    LINE (108,DOVE+3,918)
  ELSE
    IF (ARC2 < 0)
    THEN
       RK=-ARC2
    ELSE
       RK=ARC2
    ENDIF
    XK=DTHICK1
    YK=DRADIUS1
    XM=DTHICK2
    YM=DRADIUS2
    CNTR-PT
    IF (ARC2 < 0)
    THEN
       POINT (924,XR,YCORD,YR)
       POINT (931,-XR,YCORD,YR)
    ELSE
       POINT (924,XL,YCORD,YL)
       POINT (931,-XL,YCORD,YL)
    ENDIF
    ARC (101,924,DOVE+1,912)
    ARC (108,931,DOVE+3,918)
(*
    DELETEPT (924)
    DELETEPT (931)
  ENDIF
(*
```

```
(* DEFINE POINTS TO CONNECT SECOND AND THIRD VALUES
(* IF ARC3 = 0, THEN CONNECT POINTS BY LINES,
(*                 ELSE CONNECT POINTS BY ARCS
(*
  IF (ARC3 = 0)
  THEN
    LINE (102,912,913)
    LINE (109,918,919)
  ELSE
    IF (ARC3 < 0)
    THEN
       RK=-ARC3
    ELSE
       RK=ARC3
    ENDIF
    XK=DTHICK2
    YK=DRADIUS2
    XM=DTHICK3
    YM=DRADIUS3
    CNTR-PT
    IF (ARC3 < 0)
    THEN
       POINT (925,XR,YCORD,YR)
       POINT (932,-XR,YCORD,YR)
    ELSE
       POINT (925,XL,YCORD,YL)
       POINT (932,-XL,YCORD,YL)
    ENDIF
    ARC (102,925,912,913)
    ARC (109,932,918,919)
(*
    DELETEPT (925)
    DELETEPT (932)
  ENDIF
(*
(* DEFINE POINTS TO CONNECT THIRD AND FOURTH VALUES
(* IF ARC4 = 0, THEN CONNECT POINTS BY LINES,
(*                 ELSE CONNECT POINTS BY ARCS
(*
  IF (ARC4 = 0)
  THEN
    LINE (103,913,914)
    LINE (110,919,920)
  ELSE
    IF (ARC4 < 0)
    THEN
       RK=-ARC4
    ELSE
       RK=ARC4
    ENDIF
    XK=DTHICK3
    YK=DRADIUS3
    XM=DTHICK4
```

```
   YM=DRADIUS4
   CNTR-PT
   IF (ARC4 < 0)
   THEN
      POINT (926.XR.YCORD.YR)
      POINT (933.-XR.YCORD.YR)
   ELSE
      POINT (926.XL.YCORD.YL)
      POINT (933.-XL.YCORD.YL)
   ENDIF
   ARC (103.926.913.914)
   ARC (110.933.919.920)
(*
   DELETEPT (926)
   DELETEPT (933)
 ENDIF
(*
(* DEFINE POINTS TO CONNECT SIXTH AND SEVENTH VALUES
(* IF ARC5 = 0, THEN CONNECT POINTS BY LINES.
(*               ELSE CONNECT POINTS BY ARCS
(*
(*
 IF (ARC5 = 0)
 THEN
   LINE (106.914.917)
   LINE (113.920.923)
 ELSE
   IF (ARC5 < 0)
   THEN
      RK=-ARC5
   ELSE
      RK=ARC5
   ENDIF
   XK=DTHICK4
   YK=DRADIUS4
   XM=DTHICK5
   YM=DRADIUS5
   CNTR-PT
   IF (ARC5 < 0)
   THEN
      POINT (929.XR.YCORD.YR)
      POINT (936.-XR.YCORD.YR)
   ELSE
      POINT (929.XL.YCORD.YL)
      POINT (936.-XL.YCORD.YL)
   ENDIF
   ARC (106.929.914.917)
   ARC (113.936.920.923)
(*
   DELETEPT (929)
   DELETEPT (936)
 ENDIF
(*
```

```
(*
(* DEFINE POINTS TO CONNECT SEVENTH AND EIGHTH VALUES
(* IF ARC6 = 0. THEN CONNECT POINTS BY LINES
(*              ELSE CONNECT POINTS BY ARCS
(*
(*
  IF (ARC6 = 0)
  THEN
    LINE (107,917,DOVE+2)
    LINE (114,923,DOVE+4)
  ELSE
    IF (ARC6 < 0)
    THEN
       RK=-ARC6
    ELSE
       RK=ARC6
    ENDIF
    XK=DTHICK5
    YK=DRADIUS5
    XM=DTHICK6
    YM=DRADIUS6
    CNTR-PT
    IF (ARC6 < 0)
    THEN
       POINT (930,XR,YCORD,YR)
       POINT (937,-XR,YCORD,YR)
    ELSE
       POINT (930,XL,YCORD,YL)
       POINT (937,-XL,YCORD,YL)
    ENDIF
    ARC (107,930,917,DOVE+2)
    ARC (114,937,923,DOVE+4)
(*
    DELETEPT (930)
    DELETEPT (937)
  ENDIF
(*
(*****************************************************************
(*                                                               *
(*              - DOVETAIL CURVE DEFINITIONS -                   *
(*                   DEFINE ESMOSS CURVES                        *
(*                                                               *
(*****************************************************************
(*
(*    DEFINE TOP CROSS-SECTION PIECE WITH STRAIGHT LINES
(*
  LINE (LDOVE+3,DOVE+35,DOVE+1)
  LINE (LDOVE+4,DOVE+33,DOVE+35)
  LINE (LDOVE+5,DOVE+3,DOVE+33)
(*
  LINE (LDOVE+6,DOVE+36,DOVE+2)
  LINE (LDOVE+7,DOVE+34,DOVE+36)
  LINE (LDOVE+8,DOVE+4,DOVE+34)
```

```
(*
  LINE (LDOVE+9,DOVE+35,DOVE+36)
  LINE (LDOVE+10,DOVE+33,DOVE+34)
(*
(*     MERGE CURVES INTO ONE CURVE TO DEFINE A SURFACE
(*
  MRGCURVE (150,101,102)
  MRGCURVE (151,150,103)
  MRGCURVE (154,151,106)
  MRGCURVE (LDOVE+1,154,107)
(*
(*
  MRGCURVE (155,108,109)
  MRGCURVE (156,155,110)
  MRGCURVE (159,156,113)
  MRGCURVE (LDOVE+2,159,114)
(*
  DELETEPT (912)
  DELETEPT (913)
  DELETEPT (914)
  DELETEPT (917)
  DELETEPT (918)
  DELETEPT (919)
  DELETEPT (920)
  DELETEPT (923)
(*
  DELETECV (101)
  DELETECV (102)
  DELETECV (103)
  DELETECV (104)
  DELETECV (105)
  DELETECV (106)
  DELETECV (107)
  DELETECV (108)
  DELETECV (109)
  DELETECV (110)
  DELETECV (111)
  DELETECV (112)
  DELETECV (113)
  DELETECV (114)
(*
  DELETECV (150)
  DELETECV (151)
  DELETECV (154)
  DELETECV (155)
  DELETECV (156)
  DELETECV (159)
(*
  IF (MOD(TIME,2) = 1)
  THEN
     YCORD=YCORD+RTHICK
  ELSE
     YCORD=YCORD+HOLE
```

```
  ENDIF
(*
  DOVE=DOVE+4
  LDOVE=LDOVE+10
  TIME=TIME+1
(*
  UNTIL (TIME=9)
(*
(* CONNECT CROSS-SECTIONS WITH LINES
(*
  DOVE=0
  LDOVE=0
(*
  LINE (LDOVE+81,DOVE+1, DOVE+5)
  LINE (LDOVE+82,DOVE+2, DOVE+6)
  LINE (LDOVE+83,DOVE+35,DOVE+39)
  LINE (LDOVE+84,DOVE+36,DOVE+40)
  LINE (LDOVE+85,DOVE+33,DOVE+37)
  LINE (LDOVE+86,DOVE+34,DOVE+38)
  LINE (LDOVE+87,DOVE+3 ,DOVE+7)
  LINE (LDOVE+88,DOVE+4, DOVE+8)
(*
  LINE (LDOVE+89,DOVE+5, DOVE+9)
  LINE (LDOVE+90,DOVE+6, DOVE+10)
  LINE (LDOVE+91,DOVE+39,DOVE+43)
  LINE (LDOVE+92,DOVE+40,DOVE+44)
  LINE (LDOVE+93,DOVE+37,DOVE+41)
  LINE (LDOVE+94,DOVE+38,DOVE+42)
  LINE (LDOVE+95,DOVE+7 ,DOVE+11)
  LINE (LDOVE+96,DOVE+8, DOVE+12)
(*
  LINE (LDOVE+97,DOVE+9, DOVE+13)
  LINE (LDOVE+98,DOVE+10,DOVE+14)
  LINE (LDOVE+99,DOVE+43,DOVE+47)
  LINE (LDOVE+100,DOVE+44,DOVE+48)
  LINE (LDOVE+101,DOVE+41,DOVE+45)
  LINE (LDOVE+102,DOVE+42,DOVE+46)
  LINE (LDOVE+103,DOVE+11,DOVE+15)
  LINE (LDOVE+104,DOVE+12,DOVE+16)
(*
  LINE (LDOVE+105,DOVE+13,DOVE+17)
  LINE (LDOVE+106,DOVE+14,DOVE+18)
  LINE (LDOVE+107,DOVE+47,DOVE+51)
  LINE (LDOVE+108,DOVE+48,DOVE+52)
  LINE (LDOVE+109,DOVE+45,DOVE+49)
  LINE (LDOVE+110,DOVE+46,DOVE+50)
  LINE (LDOVE+111,DOVE+15,DOVE+19)
  LINE (LDOVE+112,DOVE+16,DOVE+20)
(*
  LINE (LDOVE+113,DOVE+17,DOVE+21)
  LINE (LDOVE+114,DOVE+18,DOVE+22)
  LINE (LDOVE+115,DOVE+51,DOVE+55)
  LINE (LDOVE+116,DOVE+52,DOVE+56)
```

```
  LINE (LDOVE+117,DOVE+49,DOVE+53)
  LINE (LDOVE+118,DOVE+50,DOVE+54)
  LINE (LDOVE+119,DOVE+19,DOVE+23)
  LINE (LDOVE+120,DOVE+20,DOVE+24)
(*
  LINE (LDOVE+121,DOVE+21,DOVE+25)
  LINE (LDOVE+122,DOVE+22,DOVE+26)
  LINE (LDOVE+123,DOVE+55,DOVE+59)
  LINE (LDOVE+124,DOVE+56,DOVE+60)
  LINE (LDOVE+125,DOVE+53,DOVE+57)
  LINE (LDOVE+126,DOVE+54,DOVE+58)
  LINE (LDOVE+127,DOVE+23,DOVE+27)
  LINE (LDOVE+128,DOVE+24,DOVE+28)
(*
  LINE (LDOVE+129,DOVE+25,DOVE+29)
  LINE (LDOVE+130,DOVE+26,DOVE+30)
  LINE (LDOVE+131,DOVE+59,DOVE+63)
  LINE (LDOVE+132,DOVE+60,DOVE+64)
  LINE (LDOVE+133,DOVE+57,DOVE+61)
  LINE (LDOVE+134,DOVE+58,DOVE+62)
  LINE (LDOVE+135,DOVE+27,DOVE+31)
  LINE (LDOVE+136,DOVE+28,DOVE+32)
(*
(*****************************************************************
(*                                                               *
(*                - DOVETAIL SURFACE DEFINITIONS -               *
(*                     DEFINE ESMOSS SURFACES                    *
(*                                                               *
(*****************************************************************
(*
  SDOVE=0
  LDOVE=0
  DOVE=0
(*
  RULEDSRF (SDOVE+1,LDOVE+1, LDOVE+9)
  RULEDSRF (SDOVE+2,LDOVE+11,LDOVE+19)
  RULEDSRF (SDOVE+3,LDOVE+9, LDOVE+19)
  RULEDSRF (SDOVE+4,LDOVE+1, LDOVE+11)
  RULEDSRF (SDOVE+5,LDOVE+3, LDOVE+13)
  RULEDSRF (SDOVE+6,LDOVE+6, LDOVE+16)
(*
(* SURFACES FOR REGION 2
(*
  RULEDSRF (SDOVE+17,LDOVE+19,LDOVE+29)
  RULEDSRF (SDOVE+18,LDOVE+11,LDOVE+21)
  RULEDSRF (SDOVE+19,LDOVE+21,LDOVE+29)
  RULEDSRF (SDOVE+20,LDOVE+13,LDOVE+23)
  RULEDSRF (SDOVE+21,LDOVE+16,LDOVE+26)
(*
(* SURFACES FOR REGION 3
(*
  RULEDSRF (SDOVE+27,LDOVE+31,LDOVE+39)
  RULEDSRF (SDOVE+28,LDOVE+29,LDOVE+39)
```

```
  RULEDSRF  (SDOVE+29,LDOVE+21,LDOVE+31)
  RULEDSRF  (SDOVE+30,LDOVE+23,LDOVE+33)
  RULEDSRF  (SDOVE+31,LDOVE+26,LDOVE+36)
(*
(* SURFACES FOR REGION 4
(*
  RULEDSRF  (SDOVE+42,LDOVE+41,LDOVE+49)
  RULEDSRF  (SDOVE+43,LDOVE+39,LDOVE+49)
  RULEDSRF  (SDOVE+44,LDOVE+31,LDOVE+41)
  RULEDSRF  (SDOVE+45,LDOVE+33,LDOVE+43)
  RULEDSRF  (SDOVE+46,LDOVE+36,LDOVE+46)
(*
(* SURFACES FOR REGION 5
(*
  RULEDSRF  (SDOVE+52,LDOVE+51,LDOVE+59)
  RULEDSRF  (SDOVE+53,LDOVE+49,LDOVE+59)
  RULEDSRF  (SDOVE+54,LDOVE+41,LDOVE+51)
  RULEDSRF  (SDOVE+55,LDOVE+43,LDOVE+53)
  RULEDSRF  (SDOVE+56,LDOVE+46,LDOVE+56)
(*
(* SURFACES FOR REGION 6
(*
  RULEDSRF  (SDOVE+66,LDOVE+61,LDOVE+69)
  RULEDSRF  (SDOVE+67,LDOVE+59,LDOVE+69)
  RULEDSRF  (SDOVE+68,LDOVE+51,LDOVE+61)
  RULEDSRF  (SDOVE+69,LDOVE+53,LDOVE+63)
  RULEDSRF  (SDOVE+70,LDOVE+56,LDOVE+66)
(*
(* SURFACES FOR REGION 7
(*
  RULEDSRF  (SDOVE+76,LDOVE+71,LDOVE+79)
  RULEDSRF  (SDOVE+77,LDOVE+69,LDOVE+79)
  RULEDSRF  (SDOVE+78,LDOVE+61,LDOVE+71)
  RULEDSRF  (SDOVE+79,LDOVE+63,LDOVE+73)
  RULEDSRF  (SDOVE+80,LDOVE+66,LDOVE+76)
(*
(* SURFACES FOR REGION 8
(*
  RULEDSRF  (SDOVE+7,  LDOVE+9,  LDOVE+10)
  RULEDSRF  (SDOVE+8,  LDOVE+19,LDOVE+20)
  RULEDSRF  (SDOVE+9,  LDOVE+10,LDOVE+20)
  RULEDSRF  (SDOVE+10,LDOVE+4,  LDOVE+14)
  RULEDSRF  (SDOVE+11,LDOVE+7,  LDOVE+17)
(*
(* SURFACES FOR REGION 9
(*
  RULEDSRF  (SDOVE+37,LDOVE+29,LDOVE+30)
  RULEDSRF  (SDOVE+38,LDOVE+39,LDOVE+40)
  RULEDSRF  (SDOVE+39,LDOVE+29,LDOVE+39)
  RULEDSRF  (SDOVE+40,LDOVE+24,LDOVE+34)
  RULEDSRF  (SDOVE+41,LDOVE+27,LDOVE+37)
(*
(* SURFACES FOR REGION 10
```

```
(*
  RULEDSRF (SDOVE+62,LDOVE+49,LDOVE+50)
  RULEDSRF (SDOVE+63,LDOVE+59,LDOVE+60)
  RULEDSRF (SDOVE+64,LDOVE+44,LDOVE+54)
  RULEDSRF (SDOVE+65,LDOVE+47,LDOVE+57)
(*
(* SURFACES FOR REGION 11
(*
  RULEDSRF (SDOVE+86,LDOVE+69,LDOVE+70)
  RULEDSRF (SDOVE+87,LDOVE+79,LDOVE+80)
  RULEDSRF (SDOVE+88,LDOVE+64,LDOVE+74)
  RULEDSRF (SDOVE+89,LDOVE+67,LDOVE+77)
(*
(* SURFACES FOR REGION 12
(*
  RULEDSRF (SDOVE+12,LDOVE+2,  LDOVE+12)
  RULEDSRF (SDOVE+13,LDOVE+12,LDOVE+20)
  RULEDSRF (SDOVE+14,LDOVE+2,  LDOVE+10)
  RULEDSRF (SDOVE+15,LDOVE+5,  LDOVE+15)
  RULEDSRF (SDOVE+16,LDOVE+8,  LDOVE+18)
(*
(* SURFACES FOR REGION 13
(*
  RULEDSRF (SDOVE+22,LDOVE+22,LDOVE+30)
  RULEDSRF (SDOVE+23,LDOVE+12,LDOVE+22)
  RULEDSRF (SDOVE+24,LDOVE+20,LDOVE+30)
  RULEDSRF (SDOVE+25,LDOVE+15,LDOVE+25)
  RULEDSRF (SDOVE+26,LDOVE+18,LDOVE+28)
(*
(* SURFACES FOR REGION 14
(*
  RULEDSRF (SDOVE+32,LDOVE+32,LDOVE+40)
  RULEDSRF (SDOVE+33,LDOVE+22,LDOVE+32)
  RULEDSRF (SDOVE+34,LDOVE+30,LDOVE+40)
  RULEDSRF (SDOVE+35,LDOVE+25,LDOVE+35)
  RULEDSRF (SDOVE+36,LDOVE+28,LDOVE+38)
(*
(* SURFACES FOR REGION 15
(*
  RULEDSRF (SDOVE+47,LDOVE+42,LDOVE+50)
  RULEDSRF (SDOVE+48,LDOVE+32,LDOVE+42)
  RULEDSRF (SDOVE+49,LDOVE+40,LDOVE+50)
  RULEDSRF (SDOVE+50,LDOVE+35,LDOVE+45)
  RULEDSRF (SDOVE+51,LDOVE+38,LDOVE+48)
(*
(* SURFACES FOR REGION 16
(*
  RULEDSRF (SDOVE+57,LDOVE+52,LDOVE+60)
  RULEDSRF (SDOVE+58,LDOVE+42,LDOVE+52)
  RULEDSRF (SDOVE+59,LDOVE+50,LDOVE+60)
  RULEDSRF (SDOVE+60,LDOVE+45,LDOVE+55)
  RULEDSRF (SDOVE+61,LDOVE+48,LDOVE+58)
(*
```

```
(* SURFACES FOR REGION 17
(*
  RULEDSRF (SDOVE+71,LDOVE+62,LDOVE+70)
  RULEDSRF (SDOVE+72,LDOVE+52,LDOVE+62)
  RULEDSRF (SDOVE+73,LDOVE+60,LDOVE+70)
  RULEDSRF (SDOVE+74,LDOVE+55,LDOVE+65)
  RULEDSRF (SDOVE+75,LDOVE+58,LDOVE+68)
(*
(* SURFACES FOR REGION 18
(*
  RULEDSRF (SDOVE+81,LDOVE+72,LDOVE+80)
  RULEDSRF (SDOVE+82,LDOVE+62,LDOVE+72)
  RULEDSRF (SDOVE+83,LDOVE+70,LDOVE+80)
  RULEDSRF (SDOVE+84,LDOVE+65,LDOVE+75)
  RULEDSRF (SDOVE+85,LDOVE+68,LDOVE+78)
(*
(******************************************************************
(*                                                                *
(*              - BROACH REGION DEFINITIONS -                     *
(*                 DEFINE ESMOSS REGIONS                          *
(*                                                                *
(******************************************************************
(*
  SDOVE=0
(*
(*              DEFINE  REGION 1
(*
  REG3D (1,SDOVE+1,SDOVE+2,SDOVE+3,SDOVE+4,SDOVE+5,SDOVE+6, &
        LDOVE+1, LDOVE+9, LDOVE+11,LDOVE+19,LDOVE+3, LDOVE+6, &
        LDOVE+13,LDOVE+16,LDOVE+81,LDOVE+82,LDOVE+83,LDOVE+84, &
        DOVE+1, DOVE+2, DOVE+5, DOVE+6, DOVE+35,DOVE+36,DOVE+39,DOVE+40)
(*
(*              DEFINE  REGION 2
(*
  REG3D (2,SDOVE+2, SDOVE+17,SDOVE+18,SDOVE+19,SDOVE+20,SDOVE+21,&
         LDOVE+11,LDOVE+19,LDOVE+21,LDOVE+29,LDOVE+13,LDOVE+16, &
         LDOVE+23,LDOVE+26,LDOVE+89,LDOVE+90,LDOVE+91,LDOVE+92, &
         DOVE+5, DOVE+6, DOVE+9, DOVE+10,DOVE+39,DOVE+40,DOVE+43, &
         DOVE+44)
(*
(*              DEFINE  REGION 3
(*
  REG3D (3,SDOVE+19,SDOVE+27,SDOVE+28,SDOVE+29,SDOVE+30,SDOVE+31,&
         LDOVE+21,LDOVE+29,LDOVE+31,LDOVE+39,LDOVE+23,LDOVE+26, &
         LDOVE+33,LDOVE+36,LDOVE+97,LDOVE+98,LDOVE+99,LDOVE+100, &
         DOVE+9, DOVE+10,DOVE+13,DOVE+14,DOVE+43,DOVE+44,DOVE+47, &
         DOVE+48)
(*
(*              DEFINE  REGION 4
(*
  REG3D (4,SDOVE+27,SDOVE+42,SDOVE+43,SDOVE+44,SDOVE+45,SDOVE+46, &
         LDOVE+31,LDOVE+39,LDOVE+41,LDOVE+49,LDOVE+33,LDOVE+36, &
         LDOVE+43,LDOVE+46,LDOVE+105,LDOVE+106,LDOVE+107,LDOVE+108, &
```

```
        DOVE+13.DOVE+14.DOVE+17.DOVE+18 DOVE+47.DOVE+48,DOVE+51. &
        DOVE+52)
(*
(*               DEFINE   REGION 5
(*
  REG3D (5.SDOVE+42,SDOVE+52.SDOVE+53.SDOVE+54 SDOVE+55.SDOVE+56. &
        LDOVE+41.LDOVE+49.LDOVE+51.LDOVE+59.LDOVE+43.LDOVE+46. &
        LDOVE+53.LDOVE+56.LDOVE+113.LDOVE+114.LDOVE+115.LDOVE+116, &
        DOVE+17,DOVE+18,DOVE+21.DOVE+22.DOVE+51,DOVE+52,DOVE+55, &
        DOVE+56)
(*
(*               DEFINE   REGION 6
(*
  REG3D (6.SDOVE+52,SDOVE+66,SDOVE+67,SDOVE+68,SDOVE+69.SDOVE+70, &
        LDOVE+51,LDOVE+59,LDOVE+61,LDOVE+69,LDOVE+53,LDOVE+56. &
        LDOVE+63,LDOVE+66,LDOVE+121,LDOVE+122,LDOVE+123,LDOVE+124, &
        DOVE+21,DOVE+22,DOVE+25.DOVE+26,DOVE+55,DOVE+56,DOVE+59, &
        DOVE+60)
(*
(*               DEFINE   REGION 7
(*
  REG3D (7.SDOVE+66,SDOVE+76.SDOVE+77,SDOVE+78.SDOVE+79,SDOVE+80, &
        LDOVE+61.LDOVE+69,LDOVE+71,LDOVE+79,LDOVE+63,LDOVE+66, &
        LDOVE+73,LDOVE+76,LDOVE+129,LDOVE+130,LDOVE+131,LDOVE+132, &
        DOVE+25.DOVE+26.DOVE+29,DOVE+30,DOVE+59.DOVE+60,DOVE+63. &
        DOVE+64)
(*
(*               DEFINE   REGION 8
(*
  REG3D (8,SDOVE+3, SDOVE+7, SDOVE+8, SDOVE+9. SDOVE+10,SDOVE+11, &
        LDOVE+9, LDOVE+10,LDOVE+19.LDOVE+20,LDOVE+4, LDOVE+7, &
        LDOVE+14.LDOVE+17,LDOVE+83.LDOVE+84.LDOVE+85,LDOVE+86, &
        DOVE+33,DOVE+34.DOVE+35,DOVE+36.DOVE+37,DOVE+38,DOVE+39, &
        DOVE+40)
(*
(*               DEFINE   REGION 9
(*
  REG3D (9,SDOVE+34,SDOVE+37.SDOVE+38.SDOVE+39.SDOVE+40,SDOVE+41. &
        LDOVE+29.LDOVE+30.LDOVE+39.LDOVE+40.LDOVE+24.LDOVE+27. &
        LDOVE+34,LDOVE+37,LDOVE+99.LDOVE+100.LDOVE+101,LDOVE+102. &
        DOVE+41,DOVE+42.DOVE+43.DOVE+44.DOVE+45.DOVE+46.DOVE+47, &
        DOVE+48)
(*
(*               DEFINE   REGION 10
(*
  REG3D(10,SDOVE+59,SDOVE+53.SDOVE+62,SDOVE+63,SDOVE+64,SDOVE+65, &
        LDOVE+49.LDOVE+50.LDOVE+59.LDOVE+60.LDOVE+44.LDOVE+47, &
        LDOVE+54,LDOVE+57,LDOVE+115,LDOVE+116.LDOVE+117,LDOVE+118, &
        DOVE+49,DOVE+50,DOVE+51,DOVE+52,DOVE+53.DOVE+54,DOVE+55, &
        DOVE+56)
(*
(*               DEFINE   REGION 11
(*
```

```
REG3D(11.SDOVE+83.SDOVE+86 SDOVE+87.SDOVE-88.SDOVE+89,SDOVE+77. &
        LDOVE+69.LDOVE+70.LDOVE+79.LDOVE+80.LDOVE+64,LDOVE+67. &
        LDOVE+74.LDOVE+77.LDOVE-131.LDOVE+132.LDOVE+133.LDOVE+134. &
        DOVE+57.DOVE+58.DOVE+59.DOVE+60 DOVE+61.DOVE+62.DOVE+63. &
        DOVE+64)
(*
(*             DEFINE  REGION 12
(*
 REG3D(12.SDOVE+9, SDOVE+12,SDOVE+13,SDOVE+14,SDOVE+15,SDOVE+16, &
        LDOVE+2, LDOVE+10,LDOVE+12,LDOVE+20,LDOVE+5, LDOVE+8, &
        LDOVE+15,LDOVE+18,LDOVE+85,LDOVE+86,LDOVE+87,LDOVE+88. &
        DOVE+3, DOVE+4, DOVE+7, DOVE+8, DOVE+33.DOVE+34,DOVE+37, &
        DOVE+38)
(*
(*             DEFINE  REGION 13
(*
 REG3D(13,SDOVE+13,SDOVE+22,SDOVE+23,SDOVE+24,SDOVE+25,SDOVE+26, &
        LDOVE+12,LDOVE+20,LDOVE+22,LDOVE+30,LDOVE+15,LDOVE+18. &
        LDOVE+25,LDOVE+28,LDOVE+93,LDOVE+94,LDOVE+95.LDOVE+96, &
        DOVE+7, DOVE+8, DOVE+11,DOVE+12,DOVE+37.DOVE+38,DOVE+41. &
        DOVE+42)
(*
(*             DEFINE  REGION 14
(*
 REG3D(14,SDOVE+22,SDOVE+32,SDOVE+33,SDOVE+34,SDOVE+35,SDOVE+36, &
        LDOVE+22,LDOVE+30,LDOVE+32,LDOVE+40.LDOVE+25,LDOVE+28, &
        LDOVE+35,LDOVE+38,LDOVE+101,LDOVE+102,LDOVE+103.LDOVE+104, &
        DOVE+11,DOVE+12,DOVE+15,DOVE+16,DOVE+41,DOVE+42.DOVE+45. &
        DOVE+46)
(*
(*             DEFINE  REGION 15
(*
 REG3D(15,SDOVE+32,SDOVE+47,SDOVE+48.SDOVE+49,SDOVE+50,SDOVE+51, &
        LDOVE+32,LDOVE+40,LDOVE+42,LDOVE+50,LDOVE+35,LDOVE+38, &
        LDOVE+45,LDOVE+48,LDOVE+109,LDOVE+110.LDOVE+111,LDOVE+112, &
        DOVE+15,DOVE+16,DOVE+19,DOVE+20,DOVE+45.DOVE+46,DOVE+49, &
        DOVE+50)
(*
(*             DEFINE  REGION 16
(*
 REG3D(16,SDOVE+47,SDOVE+57.SDOVE+58 SDOVE+59.SDOVE-60.SDOVE+61, &
        LDOVE+42.LDOVE+50.LDOVE+52.LDOVE+60.LDOVE+45.LDOVE+48. &
        LDOVE+55.LDOVE+58.LDOVE+117.LDOVE+118.LDOVE+119.LDOVE+120. &
        DOVE+19.DOVE+20.DOVE+23,DOVE+24.DOVE+49.DOVE+50.DOVE+53. &
        DOVE+54)
(*
(*             DEFINE  REGION 17
(*
 REG3D(17,SDOVE+57,SDOVE+71,SDOVE+72.SDOVE+73.SDOVE+74,SDOVE+75, &
        LDOVE+52,LDOVE+60,LDOVE+62,LDOVE+70,LDOVE+55,LDOVE+58, &
        LDOVE+65,LDOVE+68,LDOVE+125.LDOVE+126,LDOVE+127,LDOVE+128. &
        DOVE+23,DOVE+24,DOVE+27,DOVE+28,DOVE+53,DOVE+54,DOVE+57, &
        DOVE+58)
```

```
(*
(*              DEFINE  REGION 18
(*
 REG3D(18,SDOVE+71,SDOVE+81,SDOVE+82,SDOVE+83,SDOVE+84,SDOVE+85, &
        LDOVE+62,LDOVE+70,LDOVE+72,LDOVE+80,LDOVE+65,LDOVE+68, &
        LDOVE+75,LDOVE+78,LDOVE+133,LDOVE+134,LDOVE+135,LDOVE+136, &
        DOVE+27,DOVE+28,DOVE+31,DOVE+32,DOVE+57,DOVE+58,DOVE+61, &
        DOVE+62)
(*
(*
```

```
(* ><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(* ><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*
(*                  DEFINE THE FIRST BLADE CROSS-SECTION
(*
(* ><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(* ><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*
  DELETEPT (801)
  DELETEPT (802)
  DELETEPT (803)
  DELETEPT (804)
  DELETEPT (805)
  DELETEPT (806)
  DELETEPT (807)
  DELETEPT (808)
(*
  DELETECV (900)
  DELETECV (901)
  DELETECV (902)
  DELETECV (903)
(*
  POINT(801,XLED1,YLED1,ZVAL1)
  POINT(802,XTED1,YTED1,ZVAL1)
  POINT(803,CXLED,CYLED,ZVAL1)
  POINT(804,CXTED,CYTED,ZVAL1)
  POINT(805,XINNER,YCENTER,ZVAL1)
  POINT(806,XOUTER,YCENTER,ZVAL1)
  POINT(807,CXINER,CYCNTR,ZVAL1)
  POINT(808,CXOTER,CYCNTR,ZVAL1)
(*
  ARC(900,806,801,802)
  ARC(901,805,801,802)
  ARC(902,808,803,804)
  ARC(903,807,803,804)
(*
  BLAD=0
(*
  PARMCRV (BLAD+161,901,.05)
  PARMCRV (BLAD+162,900,.05)
  PARMCRV (BLAD+163,903,.05)
  PARMCRV (BLAD+164,902,.05)
  PARMCRV (BLAD+165,901,(POS1+.05))
  PARMCRV (BLAD+166,903,POS1)
  PARMCRV (BLAD+167,902,POS1)
  PARMCRV (BLAD+168,900,(POS1+.05))
  PARMCRV (BLAD+169,901,(WPOS1+.05))
(*
  PARMCRV (BLAD+170,903,WPOS1)
  PARMCRV (BLAD+171,902,WPOS1)
  PARMCRV (BLAD+172,900,(WPOS1+.05))
  PARMCRV (BLAD+173,901,(POS2+.05))
```

```
  PARMCRV (BLAD+174,903,POS2)
  PARMCRV (BLAD+175,902,POS2)
  PARMCRV (BLAD+176,900,(POS2+.05))
  PARMCRV (BLAD+177,901,(WPOS2+.05))
  PARMCRV (BLAD+178,903,WPOS2)
  PARMCRV (BLAD+179,902,WPOS2)
(*
  PARMCRV (BLAD+180,900,(WPOS2+.05))
  PARMCRV (BLAD+181,901,POS3)
  PARMCRV (BLAD+182,903,POS3)
  PARMCRV (BLAD+183,902,POS3)
  PARMCRV (BLAD+184,900,POS3)
  PARMCRV (BLAD+185,901,WPOS3)
  PARMCRV (BLAD+186,903,WPOS3)
  PARMCRV (BLAD+187,902,WPOS3)
  PARMCRV (BLAD+188,900,WPOS3)
  PARMCRV (BLAD+189,901,(POS4-.05))
(*
  PARMCRV (BLAD+190,903,POS4)
  PARMCRV (BLAD+191,902,POS4)
  PARMCRV (BLAD+192,900,(POS4-.05))
  PARMCRV (BLAD+193,901,(WPOS4-.05))
  PARMCRV (BLAD+194,903,WPOS4)
  PARMCRV (BLAD+195,902,WPOS4)
  PARMCRV (BLAD+196,900,(WPOS4-.05))
  PARMCRV (BLAD+197,901,.90)
  PARMCRV (BLAD+198,903,.97)
  PARMCRV (BLAD+199,902,.97)
(*
  PARMCRV (BLAD+200,900,.90)
  PARMCRV (BLAD+201,901,.97)
  PARMCRV (BLAD+202,900,.97)
(*
(* CONSTRUCT TEMPORARY POINTS NEEDED TO DEFINE CURVES
(*
  PARMCRV (900,900,(POS1/2))
  PARMCRV (901,900,(POS1+WPOS1+.1)/2)
  PARMCRV (902,900,(WPOS1+POS2+.1)/2)
  PARMCRV (903,900,(POS2+WPOS2+.1)/2)
  PARMCRV (904,900,(WPOS2+POS3+.05)/2)
  PARMCRV (905,900,(POS3+WPOS3)/2)
  PARMCRV (906,900,(WPOS3+POS4)/2)
  PARMCRV (907,900,(POS4+WPOS4-.1)/2)
  PARMCRV (908,900,(WPOS4+.90)/2)
  PARMCRV (909,900,.935)
(*
  PARMCRV (910,902,(POS1/2))
  PARMCRV (911,902,(POS1+WPOS1)/2)
  PARMCRV (912,902,(WPOS1+POS2)/2)
  PARMCRV (913,902,(POS2+WPOS2)/2)
  PARMCRV (914,902,(WPOS2+POS3)/2)
  PARMCRV (915,902,(POS3+WPOS3)/2)
  PARMCRV (916,902,(WPOS3+POS4)/2)
```

```
  PARMCRV (917.902.(POS4+WPOS4)/2)
  PARMCRV (918.902.(WPOS4+.97)/2)
(*
  PARMCRV (919.903.(POS1/2))
  PARMCRV (920.903.(POS1+WPOS1)/2)
  PARMCRV (921.903.(WPOS1+POS2)/2)
  PARMCRV (922.903.(POS2+WPOS2)/2)
  PARMCRV (923.903.(WPOS2+POS3)/2)
  PARMCRV (924.903.(POS3+WPOS3)/2)
  PARMCRV (925.903.(WPOS3+POS4)/2)
  PARMCRV (926.903.(POS4+WPOS4)/2)
  PARMCRV (927.903.(WPOS4+.97)/2)
(*
  PARMCRV (928.901.(POS1/2))
  PARMCRV (929.901.(POS1+WPOS1+.1)/2)
  PARMCRV (930.901.(WPOS1+POS2+.1)/2)
  PARMCRV (931.901.(POS2+WPOS2+.1)/2)
  PARMCRV (932.901.(WPOS2+POS3+.05)/2)
  PARMCRV (933.901.(POS3+WPOS3)/2)
  PARMCRV (934.901.(WPOS3+POS4)/2)
  PARMCRV (935.901.(POS4+WPOS4-.1)/2)
  PARMCRV (936,901,(WPOS4+.90)/2)
  PARMCRV (937,901,.935)
(*
(*****************************************************************
(*                                                               *
(*                   -  BLADE CURVE DEFINITIONS -                *
(*                      DEFINE ESMOSS CURVES                     *
(*                                                               *
(*****************************************************************
(*
(*
  LBLD = 0
(*
  LINE (LBLD+365.BLAD+161.BLAD+162)
  LINE (LBLD+366.PLAT+98 .BLAD+161)
  LINE (LBLD+367,PLAT+99 .BLAD+162)
  LINE (LBLD+368.BLAD+161.BLAD+163)
  LINE (LBLD+369.BLAD+162.BLAD+164)
  LINE (LBLD+370.BLAD+163.BLAD+164)
  LINE (LBLD+371.PLAT+103.BLAD+163)
  LINE (LBLD+372.PLAT+104.BLAD+164)
  ARCCF(LBLD+373.BLAD+161,BLAD+165.928)
  LINE (LBLD+374.PLAT+102,BLAD+165)
  LINE (LBLD+375.PLAT+105,BLAD+166)
  LINE (LBLD+376.BLAD+163,BLAD+166)
  LINE (LBLD+377.BLAD+164,BLAD+167)
  LINE (LBLD+378,PLAT+106,BLAD+167)
  LINE (LBLD+379,PLAT+107,BLAD+168)
(*
  ARCCF(LBLD+380.BLAD+162,BLAD+168,900)
  LINE (LBLD+381.BLAD+165.BLAD+169)
  LINE (LBLD+382.BLAD+166,BLAD+170)
```

```
LINE (LBLD+383.BLAD+167.BLAD+171)
LINE (LBLD+384.BLAD+168.BLAD+172)
LINE (LBLD+385.PLAT+110.BLAD+169)
LINE (LBLD+386.PLAT+111.BLAD+170)
LINE (LBLD+387.PLAT+112.BLAD+171)
LINE (LBLD+388.PLAT+113.BLAD+172)
LINE (LBLD+389.PLAT+116.BLAD+173)
(*
LINE (LBLD+390.BLAD+165.BLAD+166)
LINE (LBLD+391.BLAD+166.BLAD+167)
LINE (LBLD+392.BLAD+167.BLAD+168)
LINE (LBLD+393.BLAD+169.BLAD+170)
LINE (LBLD+394.BLAD+170.BLAD+171)
LINE (LBLD+395.BLAD+171.BLAD+172)
ARCCF(LBLD+396.BLAD+169.BLAD+173.930)
LINE (LBLD+397.BLAD+170.BLAD+174)
LINE (LBLD+398.BLAD+171.BLAD+175)
ARCCF(LBLD+399.BLAD+172.BLAD+176.902)
(*
LINE (LBLD+400.PLAT+117.BLAD+174)
LINE (LBLD+401.BLAD+173.BLAD+174)
LINE (LBLD+402.BLAD+174.BLAD+175)
LINE (LBLD+403.PLAT+118.BLAD+175)
LINE (LBLD+404.BLAD+175.BLAD+176)
LINE (LBLD+405 PLAT+119.BLAD+176)
LINE (LBLD+406.BLAD+173.BLAD+177)
LINE (LBLD+407.BLAD+174.BLAD+178)
LINE (LBLD+408.BLAD+175.BLAD+179)
LINE (LBLD+409.BLAD+176.BLAD+180)
LINE (LBLD+410.PLAT+122.BLAD+177)
LINE (LBLD+411.BLAD+177.BLAD+178)
LINE (LBLD+412.PLAT+123.BLAD+178)
LINE (LBLD+413.BLAD+178.BLAD+179)
LINE (LBLD+414.PLAT+124.BLAD+179)
LINE (LBLD+415.BLAD+179.BLAD+180)
LINE (LBLD+416.PLAT+125.BLAD+180)
ARCCF(LBLD+417.BLAD+177.BLAD+181.932)
LINE (LBLD+418.BLAD+178.BLAD+182)
LINE (LBLD+419.BLAD+179.BLAD+183)
(*
ARCCF(LBLD+420.BLAD+180.BLAD+184.904)
LINE (LBLD+421.PLAT+128.BLAD+181)
LINE (LBLD+422.BLAD+181.BLAD+182)
LINE (LBLD+423.PLAT+129.BLAD+182)
LINE (LBLD+424.BLAD+182.BLAD+183)
LINE (LBLD+425.PLAT+130.BLAD+183)
LINE (LBLD+426.BLAD+183.BLAD+184)
LINE (LBLD+427.PLAT+131.BLAD+184)
LINE (LBLD+428.BLAD+181.BLAD+185)
LINE (LBLD+429.BLAD+182.BLAD+186)
(*
LINE (LBLD+430.BLAD+183.BLAD+187)
LINE (LBLD+431.BLAD+184.BLAD+188)
```

```
LINE  (LBLD+432,PLAT+134,BLAD+185)
LINE  (LBLD+433,BLAD+185,BLAD+186)
LINE  (LBLD+434,PLAT+135,BLAD+186)
LINE  (LBLD+435,BLAD+186,BLAD+187)
LINE  (LBLD+436,PLAT+136,BLAD+187)
LINE  (LBLD+437,BLAD+187,BLAD+188)
LINE  (LBLD+438,PLAT+137,BLAD+188)
ARCCF(LBLD+439,BLAD+185,BLAD+189,934)
(*
LINE  (LBLD+440,BLAD+186,BLAD+190)
LINE  (LBLD+441,BLAD+187,BLAD+191)
ARCCF(LBLD+442,BLAD+188,BLAD+192,906)
LINE  (LBLD+443,PLAT+140,BLAD+189)
LINE  (LBLD+444,BLAD+189,BLAD+190)
LINE  (LBLD+445,PLAT+141,BLAD+190)
LINE  (LBLD+446,BLAD+190,BLAD+191)
LINE  (LBLD+447,PLAT+142,BLAD+191)
LINE  (LBLD+448,BLAD+191,BLAD+192)
LINE  (LBLD+449,PLAT+143,BLAD+192)
(*
LINE  (LBLD+450,BLAD+189,BLAD+193)
LINE  (LBLD+451,BLAD+190,BLAD+194)
LINE  (LBLD+452,BLAD+191,BLAD+195)
LINE  (LBLD+453,BLAD+192,BLAD+196)
LINE  (LBLD+454,PLAT+146,BLAD+193)
LINE  (LBLD+455,BLAD+193,BLAD+194)
LINE  (LBLD+456,PLAT+147,BLAD+194)
LINE  (LBLD+457,BLAD+194,BLAD+195)
LINE  (LBLD+458,PLAT+148,BLAD+195)
LINE  (LBLD+459,BLAD+195,BLAD+196)
(*
LINE  (LBLD+460,PLAT+149,BLAD+196)
ARCCF(LBLD+461,BLAD+193,BLAD+197,936)
LINE  (LBLD+462,BLAD+194,BLAD+198)
LINE  (LBLD+463,BLAD+195,BLAD+199)
ARCCF(LBLD+464,BLAD+196,BLAD+200,908)
LINE  (LBLD+465,PLAT+152,BLAD+197)
LINE  (LBLD+466,BLAD+198,BLAD+197)
LINE  (LBLD+467,PLAT+153,BLAD+198)
LINE  (LBLD+468,PLAT+154,BLAD+199)
LINE  (LBLD+469,BLAD+199,BLAD+200)
(*
LINE  (LBLD+470,PLAT+155,BLAD+200)
LINE  (LBLD+471,BLAD+197,BLAD+200)
ARCCF(LBLD+472,BLAD+197,BLAD+201,937)
ARCCF(LBLD+473,BLAD+200,BLAD+202,909)
LINE  (LBLD+474,PLAT+157,BLAD+201)
LINE  (LBLD+475,PLAT+158,BLAD+202)
LINE  (LBLD+476,BLAD+201,BLAD+202)
(*
LINE  (LBLD+815,BLAD+198,BLAD+199)
(*
(* DELETE TEMPORARY POINTS THAT WERE CONSTRUCTED
```

```
(*
  DELETEPT (900)
  DELETEPT (901)
  DELETEPT (902)
  DELETEPT (903)
  DELETEPT (904)
  DELETEPT (905)
  DELETEPT (906)
  DELETEPT (907)
  DELETEPT (908)
  DELETEPT (909)
(*
  DELETEPT (910)
  DELETEPT (911)
  DELETEPT (912)
  DELETEPT (913)
  DELETEPT (914)
  DELETEPT (915)
  DELETEPT (916)
  DELETEPT (917)
  DELETEPT (918)
  DELETEPT (919)
(*
  DELETEPT (920)
  DELETEPT (921)
  DELETEPT (922)
  DELETEPT (923)
  DELETEPT (924)
  DELETEPT (925)
  DELETEPT (926)
  DELETEPT (927)
  DELETEPT (928)
  DELETEPT (929)
(*
  DELETEPT (930)
  DELETEPT (931)
  DELETEPT (932)
  DELETEPT (933)
  DELETEPT (934)
  DELETEPT (935)
  DELETEPT (936)
  DELETEPT (937)
(*
(***********************************************************************
(*                                                                     *
(*                 - BLADE SURFACE DEFINITIONS -                       *
(*                    DEFINE ESMOSS SURFACES                           *
(*                                                                     *
(***********************************************************************
(*
  SBLD=0
(*
(*
```

```
(* SURFACES FOR REGION 68
(*
  RULEDSRF (SBLD+650.LBLD+365.LBLD+370)
  RULEDSRF (SBLD+331.PLAT+203.LBLD-810)
  RULEDSRF (SBLD+332.PLAT+215 LBLD+368)
  RULEDSRF (SBLD+333.PLAT+218.LBLD+369)
  RULEDSRF (SBLD+334.PLAT+203.LBLD+365)
  RULEDSRF (SBLD+335.PLAT+810.LBLD+370)
(*
(* SURFACES FOR REGION 69
(*
  RULEDSRF (SBLD+336,PLAT+212,LBLD+373)
  RULEDSRF (SBLD+337,PLAT+800,LBLD+390)
  RULEDSRF (SBLD+338,PLAT+214,LBLD+376)
  RULEDSRF (SBLD+339,LBLD+373,LBLD+376)
(*
(* SURFACES FOR REGION 70
(*
  RULEDSRF (SBLD+340,PLAT+236,LBLD+381)
  RULEDSRF (SBLD+341,PLAT+801,LBLD+393)
  RULEDSRF (SBLD+342,PLAT+237,LBLD+382)
  RULEDSRF (SBLD+343,LBLD+381,LBLD+382)
(*
(* SURFACES FOR REGION 71
(*
  RULEDSRF (SBLD+344,PLAT+242,LBLD+396)
  RULEDSRF (SBLD+345,PLAT+250,LBLD+401)
  RULEDSRF (SBLD+346,PLAT+243,LBLD+397)
  RULEDSRF (SBLD+347,LBLD+396,LBLD+397)
(*
(* SURFACES FOR REGION 72
(*
  RULEDSRF (SBLD+348,PLAT+259,LBLD+406)
  RULEDSRF (SBLD+349,PLAT+267,LBLD+411)
  RULEDSRF (SBLD+350,PLAT+260,LBLD+407)
  RULEDSRF (SBLD+351,LBLD+406,LBLD+407)
(*
(* SURFACES FOR REGION 73
(*
  RULEDSRF (SBLD+352,PLAT+276,LBLD+417)
  RULEDSRF (SBLD+353,PLAT+284,LBLD+422)
  RULEDSRF (SBLD+354,PLAT+277,LBLD+418)
  RULEDSRF (SBLD+355,LBLD+417,LBLD+418)
(*
(* SURFACES FOR REGION 74
(*
  RULEDSRF (SBLD+356,PLAT+293,LBLD+428)
  RULEDSRF (SBLD+357,PLAT+301,LBLD+433)
  RULEDSRF (SBLD+358,PLAT+294,LBLD+429)
  RULEDSRF (SBLD+359,LBLD+428,LBLD+429)
(*
(* SURFACES FOR REGION 75
(*
```

```
  RULEDSRF (SBLD+360,PLAT+310,LBLD+439)
  RULEDSRF (SBLD+361,PLAT+318,LBLD+444)
  RULEDSRF (SBLD+362,PLAT+311,LBLD+440)
  RULEDSRF (SBLD+363,LBLD+439,LBLD+440)
(*
(* SURFACES FOR REGION 76
(*
  RULEDSRF (SBLD+364,PLAT+806,LBLD+450)
  RULEDSRF (SBLD+365,PLAT+329,LBLD+455)
  RULEDSRF (SBLD+366,PLAT+807,LBLD+451)
  RULEDSRF (SBLD+367,LBLD+450,LBLD+451)
(*
(* SURFACES FOR REGION 77
(*
  RULEDSRF (SBLD+368,PLAT+338,LBLD+461)
  RULEDSRF (SBLD+369,PLAT+345,LBLD+466)
  RULEDSRF (SBLD+370,PLAT+339,LBLD+462)
  RULEDSRF (SBLD+371,LBLD+461,LBLD+462)
(*
(* SURFACES FOR REGION 78
(*
  RULEDSRF (SBLD+372,PLAT+811,LBLD+391)
  RULEDSRF (SBLD+373,PLAT+230,LBLD+394)
  RULEDSRF (SBLD+374,PLAT+238,LBLD+383)
  RULEDSRF (SBLD+375,LBLD+382,LBLD+383)
(*
(* SURFACES FOR REGION 79
(*
  RULEDSRF (SBLD+376,PLAT+269,LBLD+413)
  RULEDSRF (SBLD+377,PLAT+261,LBLD+408)
  RULEDSRF (SBLD+378,PLAT+252,LBLD+402)
  RULEDSRF (SBLD+379,LBLD+407,LBLD+408)
(*
(* SURFACES FOR REGION 80
(*
  RULEDSRF (SBLD+380,PLAT+303,LBLD+435)
  RULEDSRF (SBLD+381,PLAT+295,LBLD+430)
  RULEDSRF (SBLD+382,PLAT+286,LBLD+424)
  RULEDSRF (SBLD+383,LBLD+429,LBLD+430)
(*
(* SURFACES FOR REGION 81
(*
  RULEDSRF (SBLD+384,PLAT+331,LBLD+457)
  RULEDSRF (SBLD+385,PLAT+808,LBLD+452)
  RULEDSRF (SBLD+386,PLAT+320,LBLD+446)
  RULEDSRF (SBLD+387,LBLD+451,LBLD+452)
(*
(* SURFACES FOR REGION 82
(*
  RULEDSRF (SBLD+388,PLAT+219,LBLD+377)
  RULEDSRF (SBLD+389,PLAT+802,LBLD+392)
  RULEDSRF (SBLD+390,PLAT+221,LBLD+380)
  RULEDSRF (SBLD+391,LBLD+377,LBLD+380)
```

```
(*
(* SURFACES FOR REGION 83
(*
  RULEDSRF (SBLD+392.PLAT+803.LBLD+395)
  RULEDSRF (SBLD+393.PLAT+239.LBLD+384)
  RULEDSRF (SBLD+394.PLAT+383.LBLD+384)
(*
(* SURFACES FOR REGION 84
(*
  RULEDSRF (SBLD+395.PLAT+244.LBLD+398)
  RULEDSRF (SBLD+396.PLAT+254.LBLD+404)
  RULEDSRF (SBLD+397.PLAT+245.LBLD+399)
  RULEDSRF (SBLD+398.LBLD+398.LBLD+399)
(*
(* SURFACES FOR REGION 85
(*
  RULEDSRF (SBLD+399.PLAT+271.LBLD+415)
  RULEDSRF (SBLD+400.PLAT+262.LBLD+409)
  RULEDSRF (SBLD+401.PLAT+408.LBLD+409)
(*
(* SURFACES FOR REGION 86
(*
  RULEDSRF (SBLD+402.PLAT+278.LBLD+419)
  RULEDSRF (SBLD+403.PLAT+288.LBLD+426)
  RULEDSRF (SBLD+404.PLAT+279.LBLD+420)
  RULEDSRF (SBLD+405.LBLD+419.LBLD+420)
(*
(* SURFACES FOR REGION 87
(*
  RULEDSRF (SBLD+406.PLAT+305.LBLD+437)
  RULEDSRF (SBLD+407.PLAT+296.LBLD+431)
  RULEDSRF (SBLD+408.LBLD+430.LBLD+431)
(*
(* SURFACES FOR REGION 86
(*
  RULEDSRF (SBLD+409.PLAT+312.LBLD+441)
  RULEDSRF (SBLD+410.PLAT+322.LBLD+448)
  RULEDSRF (SBLD+411.PLAT+313.LBLD+442)
  RULEDSRF (SBLD+412.LBLD+441.LBLD+442)
(*
(* SURFACES FOR REGION 89
(*
  RULEDSRF (SBLD+413.PLAT+333.LBLD+459)
  RULEDSRF (SBLD+414.PLAT+809.LBLD+453)
  RULEDSRF (SBLD+415.LBLD+452.LBLD+453)
(*
(* SURFACES FOR REGION 90
(*
  RULEDSRF (SBLD+416.PLAT+340.LBLD+463)
  RULEDSRF (SBLD+417.PLAT+349.LBLD+469)
  RULEDSRF (SBLD+418.PLAT+341.LBLD+464)
  RULEDSRF (SBLD+419.LBLD+463.LBLD+464)
(*
```

```
(* SURFACES FOR REGION 91
(*
  RULEDSRF (SBLD+420,PLAT+348,LBLD+815)
  RULEDSRF (SBLD+421,PLAT+351,LBLD+471)
  RULEDSRF (SBLD+422,LBLD+466,LBLD+469)
(*
(* SURFACES FOR REGION 92
(*
  RULEDSRF (SBLD+423,PLAT+354,LBLD+472)
  RULEDSRF (SBLD+424,PLAT+356,LBLD+473)
  RULEDSRF (SBLD+425,PLAT+472,LBLD+473)
  RULEDSRF (SBLD+426,LBLD+359,LBLD+476)
(*
(*****************************************************************
(*                                                               *
(*                  - BLADE REGION DEFINITIONS -                 *
(*                     DEFINE ESMOSS REGIONS                     *
(*                                                               *
(*****************************************************************
(*
(*              DEFINE REGION 68
(*
  REG3D (68,SBLD+650,SBLD+331,SBLD+332,SBLD+333,SBLD+334,SBLD+335, &
         PLAT+203,PLAT+215,PLAT+810,PLAT+218,LBLD+365,LBLD+368, &
         LBLD+369,LBLD+370,LBLD+366,LBLD+367,LBLD+371,LBLD+372, &
         PLAT+98 ,PLAT+99 ,PLAT+103,PLAT+104,BLAD+161,BLAD+162, &
         BLAD+163,BLAD+164)
(*
(*              DEFINE REGION 69
(*
  REG3D (69,SBLD+332,SBLD+336,SBLD+337,SBLD+338,SBLD+339,PLAT+304, &
         PLAT+215,PLAT+212,PLAT+800,PLAT+214,LBLD+373,LBLD+390, &
         LBLD+376,LBLD+368,LBLD+366,LBLD+374,LBLD+375,LBLD+371, &
         PLAT+98 ,PLAT+102,PLAT+103,PLAT+105,BLAD+161,BLAD+163, &
         BLAD+165,BLAD+166)
(*
(*              DEFINE REGION 70
(*
  REG3D (70,SBLD+337,SBLD+340,SBLD+341,SBLD+342,SBLD+343,PLAT+309, &
         PLAT+800,PLAT+236,PLAT+[illegible],PLAT+237,LBLD+381,LBLD+393, &
         LBLD+382,LBLD+390,LBLD+[illegible],LBLD+385,LBLD+375,LBLD+386, &
         PLAT+102,PLAT+105,PLAT+110,PLAT+111,BLAD+165,BLAD+166, &
         BLAD+169,BLAD+170)
(*
(*              DEFINE REGION 71
(*
  REG3D (71,SBLD+341,SBLD+344,SBLD+345,SBLD+346,SBLD+347,PLAT+314, &
         PLAT+242,PLAT+250,PLAT+243,PLAT+801,LBLD+396,LBLD+401, &
         LBLD+397,LBLD+393,LBLD+385,LBLD+400,LBLD+389,LBLD+386, &
         PLAT+110,PLAT+111,PLAT+116,PLAT+117,BLAD+169,BLAD+170, &
         BLAD+173,BLAD+174)
(*
(*              DEFINE REGION 72
```

```
(*
  REG3D (72.SBLD+345.SBLD+348.SBLD+349.SBLD+350.SBLD+351.PLAT+319. &
         PLAT+250.PLAT+259.PLAT+267.PLAT+260.LBLD+401.LBLD+406. &
         LBLD+411.LBLD+407.LBLD+389.LBLD+410.LBLD+412.LBLD+400. &
         PLAT+116.PLAT+117.PLAT+122.PLAT+123.BLAD+173.BLAD+174. &
         BLAD+177.BLAD+178)
(*
(*          DEFINE REGION 73
(*
  REG3D (73.SBLD+349.SBLD+352.SBLD+353.SBLD+354.SBLD+355.PLAT+324. &
         PLAT+267.PLAT+276.PLAT+277.PLAT+284.LBLD+411.LBLD+417. &
         LBLD+418.LBLD+422.LBLD+410.LBLD+412.LBLD+421.LBLD+423. &
         PLAT+122.PLAT+123.PLAT+128.PLAT+129.BLAD+177.BLAD+178. &
         BLAD+181.BLAD+182)
(*
(*          DEFINE REGION 74
(*
  REG3D (74.SBLD+353.SBLD+356.SBLD+357.SBLD+358.SBLD+359.PLAT+329. &
         PLAT+284.PLAT+293.PLAT+301.PLAT+294.LBLD+422.LBLD+428. &
         LBLD+433.LBLD+429.LBLD+421.LBLD+432.LBLD+423.LBLD+434. &
         PLAT+128.PLAT+129.PLAT+134.PLAT+135.BLAD+181.BLAD+182. &
         BLAD+185.BLAD+186)
(*
(*          DEFINE REGION 75
(*
  REG3D (75.SBLD+357.SBLD+360.SBLD+361.SBLD+362.SBLD+363.PLAT+150. &
         PLAT+301.PLAT+310.PLAT+318.PLAT+311.LBLD+439.LBLD+444. &
         LBLD+440.LBLD+433.LBLD+432.LBLD+443.LBLD+445.LBLD+434. &
         PLAT+134.PLAT+135.PLAT+140.PLAT+141.BLAD+185.BLAD+186. &
         BLAD+189.BLAD+190)
(*
(*          DEFINE REGION 76
(*
  REG3D (76.SBLD+361.SBLD+364.SBLD+365.SBLD+366.SBLD+367.PLAT+155. &
         PLAT+806.PLAT+329.PLAT+807.PLAT+318.LBLD+450.LBLD+451. &
         LBLD+444.LBLD+455.LBLD+443.LBLD+454.LBLD+445.LBLD+456. &
         PLAT+140.PLAT+141.PLAT+146.PLAT+147.BLAD+189.BLAD+190. &
         BLAD+193.BLAD+194)
(*
(*          DEFINE REGION 77
(*
  REG3D (77.SBLD+365.SBLD+368.SBLD+369.SBLD+370.SBLD+371.PLAT+160. &
         PLAT+329.PLAT+338.PLAT+345.PLAT+339.LBLD+461.LBLD+466. &
         LBLD+462.LBLD+455.LBLD+454.LBLD+465.LBLD+467.LBLD+456. &
         PLAT+146.PLAT+147.PLAT+152.PLAT+153.BLAD+193.BLAD+194. &
         BLAD+197.BLAD+198)
(*
(*          DEFINE REGION 78
(*
  REG3D (78.SBLD+342.SBLD+372.SBLD+373.SBLD+374.SBLD+375.PLAT+175. &
         PLAT+237.PLAT+230.PLAT+238.PLAT+811.LBLD+382.LBLD+394. &
         LBLD+383.LBLD+391.LBLD+375.LBLD+386.LBLD+387.LBLD+378. &
         PLAT+105.PLAT+106.PLAT+111.PLAT+112.BLAD+166.BLAD+167. &
```

```
        BLAD+170,BLAD+171)
(*
(*              DEFINE REGION 79
(*
  REG3D (79,SBLD+350,SBLD+376,SBLD+377,SBLD+378,SBLD+379,PLAT+180, &
        PLAT+260,PLAT+269,PLAT+261,PLAT+252,LBLD+407,LBLD+413, &
        LBLD+408,LBLD+402,LBLD+400,LBLD+412,LBLD+414,LBLD+403, &
        PLAT+117,PLAT+118,PLAT+123,PLAT+124,BLAD+174,BLAD+175, &
        BLAD+178,BLAD+179)
(*
(*              DEFINE REGION 80
(*
  REG3D (80,SBLD+358,SBLD+380,SBLD+381,SBLD+382,SBLD+383,PLAT+185, &
        PLAT+286,PLAT+294,PLAT+295,PLAT+303,LBLD+429,LBLD+424, &
        LBLD+435,LBLD+430,LBLD+423,LBLD+434,LBLD+436,LBLD+425, &
        PLAT+129,PLAT+130,PLAT+135,PLAT+136,BLAD+182,BLAD+183, &
        BLAD+186,BLAD+187)
(*
(*              DEFINE REGION 81
(*
  REG3D (81,SBLD+366,SBLD+384,SBLD+385,SBLD+386,SBLD+387,PLAT+190, &
        PLAT+807,PLAT+331,PLAT+808,PLAT+320,LBLD+451,LBLD+457, &
        LBLD+452,LBLD+446,LBLD+445,LBLD+456,LBLD+447,LBLD+458, &
        PLAT+141,PLAT+142,PLAT+147,PLAT+148,BLAD+190,BLAD+191, &
        BLAD+194,BLAD+195)
(*
(*              DEFINE REGION 82
(*
  REG3D (82,SBLD+333,SBLD+388,SBLD+389,SBLD+390,SBLD+391,PLAT+204, &
        PLAT+219,PLAT+802,PLAT+221,PLAT+218,LBLD+369,LBLD+377, &
        LBLD+392,LBLD+380,LBLD+372,LBLD+378,LBLD+379,LBLD+367, &
        PLAT+99 ,PLAT+104,PLAT+106,PLAT+107,BLAD+162,BLAD+164, &
        BLAD+167,BLAD+168)
(*
(*              DEFINE REGION 83
(*
  REG3D (83,SBLD+389,SBLD+374,SBLD+392,SBLD+393,SBLD+394,PLAT+208, &
        PLAT+238,PLAT+803,PLAT+239,PLAT+802,LBLD+383,LBLD+395, &
        LBLD+384,LBLD+392,LBLD+378,LBLD+387,LBLD+388,LBLD+379, &
        PLAT+106,PLAT+107,PLAT+112,PLAT+113,BLAD+167,BLAD+168, &
        BLAD+171,BLAD+172)
(*
(*              DEFINE REGION 84
(*
  REG3D (84,SBLD+392,SBLD+395,SBLD+396,SBLD+397,SBLD+398,PLAT+213, &
        PLAT+244,PLAT+254,PLAT+245,PLAT+803,LBLD+398,LBLD+404, &
        LBLD+399,LBLD+395,LBLD+387,LBLD+403,LBLD+405,LBLD+388, &
        PLAT+112,PLAT+113,PLAT+118,PLAT+119,BLAD+171,BLAD+172, &
        BLAD+175,BLAD+176)
(*
(*              DEFINE REGION 85
(*
  REG3D (85,SBLD+396,SBLD+377,SBLD+399,SBLD+400,SBLD+401,PLAT+218, &
```

```
        PLAT+261.PLAT+271.PLAT+262.PLAT+254 LBLD+408.LBLD+415,  &
        LBLD+409.LBLD+404.LBLD+403.LBLD+414.LBLD+416.LBLD+405,  &
        PLAT+118.PLAT+119.PLAT+124.PLAT+125.BLAD+175.BLAD+176,  &
        BLAD+179.BLAD+180)
(*
(*              DEFINE REGION 86
(*
 REG3D (86,SBLD+399,SBLD+402,SBLD+403,SBLD+404,SBLD+405,PLAT+223,  &
        PLAT+278,PLAT+288,PLAT+279,PLAT+271,LBLD+419,LBLD+426,  &
        LBLD+420,LBLD+415,LBLD+414,LBLD+425,LBLD+427,LBLD+416,  &
        PLAT+124,PLAT+125,PLAT+130,PLAT+131,BLAD+179,BLAD+180,  &
        BLAD+183,BLAD+184)
(*
(*              DEFINE REGION 87
(*
 REG3D (87,SBLD+403,SBLD+406,SBLD+407,SBLD+408,SBLD+381,PLAT+228,  &
        PLAT+295,PLAT+305,PLAT+296,PLAT+288,LBLD+430,LBLD+437,  &
        LBLD+431,LBLD+426,LBLD+425,LBLD+436,LBLD+438,LBLD+427,  &
        PLAT+130,PLAT+131,PLAT+136,PLAT+137,BLAD+183,BLAD+184,  &
        BLAD+187,BLAD+188)
(*
(*              DEFINE REGION 88
(*
 REG3D (88,SBLD+406,SBLD+409,SBLD+410,SBLD+411,SBLD+412,PLAT+233,  &
        PLAT+305,PLAT+312,PLAT+322,PLAT+313,LBLD+437,LBLD+441,  &
        LBLD+448,LBLD+442,LBLD+436,LBLD+447,LBLD+449,LBLD+438,  &
        PLAT+136,PLAT+137,PLAT+142,PLAT+143,BLAD+187,BLAD+188,  &
        BLAD+191,BLAD+192)
(*
(*              DEFINE REGION 89
(*
 REG3D (89,SBLD+410,SBLD+385,SBLD+413,SBLD+414,SBLD+415,PLAT+238,  &
        PLAT+808,PLAT+809,PLAT+333,PLAT+322,LBLD+452,LBLD+459,  &
        LBLD+453,LBLD+448,LBLD+447,LBLD+458,LBLD+460,LBLD+449,  &
        PLAT+142,PLAT+143,PLAT+148,PLAT+149,BLAD+191,BLAD+192,  &
        BLAD+195,BLAD+196)
(*
(*              DEFINE REGION 90
(*
 REG3D (90,SBLD+413,SBLD+416,SBLD+417,SBLD+418,SBLD+419,PLAT+243,  &
        PLAT+340,PLAT+349,PLAT+341,PLAT+333,LBLD+463,LBLD+469,  &
        LBLD+464,LBLD+459,LBLD+458,LBLD+468,LBLD+470,LBLD+460,  &
        PLAT+148,PLAT+149,PLAT+154,PLAT+155,BLAD+195,BLAD+196,  &
        BLAD+199,BLAD+200)
(*
(*              DEFINE REGION 91
(*
 REG3D (91,SBLD+417,SBLD+420,SBLD+421,SBLD+422,SBLD+369,PLAT+200,  &
        PLAT+345,PLAT+351,PLAT+349,PLAT+348,LBLD+466,LBLD+471,  &
        LBLD+469,LBLD+815,LBLD+467,LBLD+468,LBLD+465,LBLD+470,  &
        PLAT+153,PLAT+154,PLAT+152,PLAT+155,BLAD+198,BLAD+199,  &
        BLAD+197,BLAD+200)
(*
```

```
(*                DEFINE REGION 92
(*
 REG3D (92,SBLD+421,SBLD+423,SBLD+424,SBLD+425,SBLD+426,PLAT+248, &
        PLAT+351,PLAT+354,PLAT+359,PLAT+356,LBLD+471,LBLD+472, &
        LBLD+476,LBLD+473,LBLD+465,LBLD+474,LBLD+475,LBLD+470, &
        PLAT+152,PLAT+155,PLAT+157,PLAT+158,BLAD+197,BLAD+200, &
        BLAD+201,BLAD+202)
(*
(*
(*><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*
(*              DEFINE THE SECOND BLADE CROSS-SECTION
(*
(*><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*
 DELETEPT (801)
 DELETEPT (802)
 DELETEPT (803)
 DELETEPT (804)
 DELETEPT (805)
 DELETEPT (806)
 DELETEPT (807)
 DELETEPT (808)
(*
 DELETECV (900)
 DELETECV (901)
 DELETECV (902)
 DELETECV (903)
(*
 POINT(801,XLED1,YLED1,ZVAL2)
 POINT(802,XTED1,YTED1,ZVAL2)
 POINT(803,CXLED,CYLED,ZVAL2)
 POINT(804,CXTED,CYTED,ZVAL2)
 POINT(805,XINNER,YCENTER,ZVAL2)
 POINT(806,XOUTER,YCENTER,ZVAL2)
 POINT(807,CXINER,CYCNTR,ZVAL2)
 POINT(808,CXOTER,CYCNTR,ZVAL2)
(*
 ARC(900,806,801,802)
 ARC(901,805,801,802)
 ARC(902,808,803,804)
 ARC(903,807,803,804)
(*
 PARMCRV (BLAD+203,901,.05)
 PARMCRV (BLAD+204,900,.05)
 PARMCRV (BLAD+205,903,.05)
 PARMCRV (BLAD+206,902,.05)
 PARMCRV (BLAD+207,901,(POS1+.05))
 PARMCRV (BLAD+208,903,POS1)
 PARMCRV (BLAD+209,902,POS1)
(*
```

```
PARMCRV (BLAD+210,900,(POS1+.05))
PARMCRV (BLAD+211,901,(WPOS1+.05))
PARMCRV (BLAD+212,903,WPOS1)
PARMCRV (BLAD+213,902,WPOS1)
PARMCRV (BLAD+214,900,(WPOS1+.05))
PARMCRV (BLAD+215,901,(POS2+.05))
PARMCRV (BLAD+216,903,POS2)
PARMCRV (BLAD+217,902,POS2)
PARMCRV (BLAD+218,900,(POS2+.05))
PARMCRV (BLAD+219,901,(WPOS2+.05))
(*
PARMCRV (BLAD+220,903,WPOS2)
PARMCRV (BLAD+221,902,WPOS2)
PARMCRV (BLAD+222,900,(WPOS2+.05))
PARMCRV (BLAD+223,901,POS3)
PARMCRV (BLAD+224,903,POS3)
PARMCRV (BLAD+225,902,POS3)
PARMCRV (BLAD+226,900,POS3)
PARMCRV (BLAD+227,901,WPOS3)
PARMCRV (BLAD+228,903,WPOS3)
PARMCRV (BLAD+229,902,WPOS3)
(*
PARMCRV (BLAD+230,900,WPOS3)
PARMCRV (BLAD+231,901,(POS4-.05))
PARMCRV (BLAD+232,903,POS4)
PARMCRV (BLAD+233,902,POS4)
PARMCRV (BLAD+234,900,(POS4-.05))
PARMCRV (BLAD+235,901,(WPOS4-.05))
PARMCRV (BLAD+236,903,WPOS4)
PARMCRV (BLAD+237,902,WPOS4)
PARMCRV (BLAD+238,900,(WPOS4-.05))
PARMCRV (BLAD+239,903,.97)
(*
PARMCRV (BLAD+240,902,.97)
PARMCRV (BLAD+241,901,.90)
PARMCRV (BLAD+242,900,.90)
PARMCRV (BLAD+243,901,.97)
PARMCRV (BLAD+244,900,.97)
(*
(*
(* CONSTRUCT TEMPORARY POINTS NEEDED TO DEFINE CURVES
(*
PARMCRV (900,900,(POS1/2))
PARMCRV (901,900,(POS1+WPOS1+.1)/2)
PARMCRV (902,900,(WPOS1+POS2+.1)/2)
PARMCRV (903,900,(POS2+WPOS2+.1)/2)
PARMCRV (904,900,(WPOS2+POS3+.05)/2)
PARMCRV (905,900,(POS3+WPOS3)/2)
PARMCRV (906,900,(WPOS3+POS4)/2)
PARMCRV (907,900,(POS4+WPOS4-.1)/2)
PARMCRV (908,900,(WPOS4+.90)/2)
PARMCRV (909,900,.935)
(*
```

```
 PARMCRV (910,902,(POS1/2))
 PARMCRV (911,902,(POS1+WPOS1)/2)
 PARMCRV (912,902,(WPOS1+POS2)/2)
 PARMCRV (913,902,(POS2+WPOS2)/2)
 PARMCRV (914,902,(WPOS2+POS3)/2)
 PARMCRV (915,902,(POS3+WPOS3)/2)
 PARMCRV (916,902,(WPOS3+POS4)/2)
 PARMCRV (917,902,(POS4+WPOS4)/2)
 PARMCRV (918,902,(WPOS4+.97)/2)
(*
 PARMCRV (919,903,(POS1/2))
 PARMCRV (920,903,(POS1+WPOS1)/2)
 PARMCRV (921,903,(WPOS1+POS2)/2)
 PARMCRV (922,903,(POS2+WPOS2)/2)
 PARMCRV (923,903,(WPOS2+POS3)/2)
 PARMCRV (924,903,(POS3+WPOS3)/2)
 PARMCRV (925,903,(WPOS3+POS4)/2)
 PARMCRV (926,903,(POS4+WPOS4)/2)
 PARMCRV (927,903,(WPOS4+.97)/2)
(*
 PARMCRV (928,901,(POS1/2))
 PARMCRV (929,901,(POS1+WPOS1+.1)/2)
 PARMCRV (930,901,(WPOS1+POS2+.1)/2)
 PARMCRV (931,901,(POS2+WPOS2+.1)/2)
 PARMCRV (932,901,(WPOS2+POS3+.05)/2)
 PARMCRV (933,901,(POS3+WPOS3)/2)
 PARMCRV (934,901,(WPOS3+POS4)/2)
 PARMCRV (935,901,(POS4+WPOS4-.1)/2)
 PARMCRV (936,901,(WPOS4+.90)/2)
 PARMCRV (937,901,.935)
(*
(*
(*******************************************************************
(*                                                                 *
(*                 - BLADE CURVE DEFINITIONS -                     *
(*                   DEFINE ESMOSS CURVES                          *
(*                                                                 *
(*******************************************************************
(*
  LINE (LBLD+477,BLAD+161,BLAD+203)
  LINE (LBLD+478,BLAD+203,BLAD+204)
  LINE (LBLD+479,BLAD+162,BLAD+204)
(*
  LINE (LBLD+480,BLAD+163,BLAD+205)
  LINE (LBLD+481,BLAD+205,BLAD+206)
  LINE (LBLD+482,BLAD+164,BLAD+206)
  ARCCF(LBLD+483,BLAD+203,BLAD+207,928)
  LINE (LBLD+484,BLAD+205,BLAD+208)
  LINE (LBLD+485,BLAD+206,BLAD+209)
  ARCCF(LBLD+486,BLAD+204,BLAD+210,900)
  LINE (LBLD+487,BLAD+165,BLAD+207)
  LINE (LBLD+488,BLAD+207,BLAD+208)
  LINE (LBLD+489,BLAD+166,BLAD+208)
```

```
(*
 LINE (LBLD+490,BLAD+208,BLAD+209)
 LINE (LBLD+491,BLAD+167,BLAD+209)
 LINE (LBLD+492,BLAD+209,BLAD+210)
 LINE (LBLD+493,BLAD+168,BLAD+210)
 LINE (LBLD+494,BLAD+207,BLAD+211)
 LINE (LBLD+495,BLAD+208,BLAD+212)
 LINE (LBLD+496,BLAD+209,BLAD+213)
 LINE (LBLD+497,BLAD+210,BLAD+214)
 LINE (LBLD+498,BLAD+169,BLAD+211)
 LINE (LBLD+499,BLAD+211,BLAD+212)
(*
 LINE (LBLD+500,BLAD+170,BLAD+212)
 LINE (LBLD+501,BLAD+212,BLAD+213)
 LINE (LBLD+502,BLAD+171,BLAD+213)
 LINE (LBLD+503,BLAD+213,BLAD+214)
 LINE (LBLD+504,BLAD+172,BLAD+214)
 ARCCF(LBLD+505,BLAD+211,BLAD+215,930)
 LINE (LBLD+506,BLAD+212,BLAD+216)
 LINE (LBLD+507,BLAD+213,BLAD+217)
 ARCCF(LBLD+508,BLAD+214,BLAD+218,902)
 LINE (LBLD+509,BLAD+173,BLAD+215)
(*
 LINE (LBLD+510,BLAD+215,BLAD+216)
 LINE (LBLD+511,BLAD+174,BLAD+216)
 LINE (LBLD+512,BLAD+216,BLAD+217)
 LINE (LBLD+513,BLAD+175,BLAD+217)
 LINE (LBLD+514,BLAD+217,BLAD+218)
 LINE (LBLD+515,BLAD+176,BLAD+218)
 LINE (LBLD+516,BLAD+215,BLAD+219)
 LINE (LBLD+517,BLAD+216,BLAD+220)
 LINE (LBLD+518,BLAD+217,BLAD+221)
 LINE (LBLD+519,BLAD+218,BLAD+222)
(*
 LINE (LBLD+520,BLAD+177,BLAD+219)
 LINE (LBLD+521,BLAD+219,BLAD+220)
 LINE (LBLD+522,BLAD+178,BLAD+220)
 LINE (LBLD+523,BLAD+220,BLAD+221)
 LINE (LBLD+524,BLAD+179,BLAD+221)
 LINE (LBLD+525,BLAD+221,BLAD+222)
 LINE (LBLD+526,BLAD+180,BLAD+222)
 ARCCF(LBLD+527,BLAD+219,BLAD+223,932)
 LINE (LBLD+528,BLAD+220,BLAD+224)
 LINE (LBLD+529,BLAD+221,BLAD+225)
(*
 ARCCF(LBLD+530,BLAD+222,BLAD+226,904)
 LINE (LBLD+531,BLAD+181,BLAD+223)
 LINE (LBLD+532,BLAD+223,BLAD+224)
 LINE (LBLD+533,BLAD+182,BLAD+224)
 LINE (LBLD+534,BLAD+224,BLAD+225)
 LINE (LBLD+535,BLAD+183,BLAD+225)
 LINE (LBLD+536,BLAD+225,BLAD+226)
 LINE (LBLD+537,BLAD+184,BLAD+226)
```

```
  LINE (LBLD+538,BLAD+223,BLAD+227)
  LINE (LBLD+539,BLAD+224,BLAD+228)
(*
  LINE (LBLD+540,BLAD+225,BLAD+229)
  LINE (LBLD+541,BLAD+226,BLAD+230)
  LINE (LBLD+542,BLAD+185,BLAD+227)
  LINE (LBLD+543,BLAD+227,BLAD+228)
  LINE (LBLD+544,BLAD+186,BLAD+228)
  LINE (LBLD+545,BLAD+228,BLAD+229)
  LINE (LBLD+546,BLAD+187,BLAD+229)
  LINE (LBLD+547,BLAD+229,BLAD+230)
  LINE (LBLD+548,BLAD+188,BLAD+230)
  ARCCF(LBLD+549,BLAD+227,BLAD+231,934)
(*
  LINE (LBLD+550,BLAD+228,BLAD+232)
  LINE (LBLD+551,BLAD+229,BLAD+233)
  ARCCF(LBLD+552,BLAD+230,BLAD+234,906)
  LINE (LBLD+553,BLAD+189,BLAD+231)
  LINE (LBLD+554,BLAD+231,BLAD+232)
  LINE (LBLD+555,BLAD+190,BLAD+232)
  LINE (LBLD+556,BLAD+232,BLAD+233)
  LINE (LBLD+557,BLAD+191,BLAD+233)
  LINE (LBLD+558,BLAD+233,BLAD+234)
  LINE (LBLD+559,BLAD+192,BLAD+234)
(*
  LINE (LBLD+560,BLAD+231,BLAD+235)
  LINE (LBLD+561,BLAD+232,BLAD+236)
  LINE (LBLD+562,BLAD+233,BLAD+237)
  LINE (LBLD+563,BLAD+234,BLAD+238)
  LINE (LBLD+564,BLAD+193,BLAD+235)
  LINE (LBLD+565,BLAD+235,BLAD+236)
  LINE (LBLD+566,BLAD+236,BLAD+237)
  LINE (LBLD+567,BLAD+195,BLAD+237)
  LINE (LBLD+568,BLAD+237,BLAD+238)
  LINE (LBLD+569,BLAD+196,BLAD+238)
(*
  ARCCF(LBLD+570,BLAD+235,BLAD+241,936)
  LINE (LBLD+571,BLAD+236,BLAD+239)
  LINE (LBLD+572,BLAD+237,BLAD+240)
  ARCCF(LBLD+573,BLAD+238,BLAD+242,908)
  LINE (LBLD+574,BLAD+198,BLAD+239)
  LINE (LBLD+575,BLAD+199,BLAD+240)
  LINE (LBLD+576,BLAD+239,BLAD+240)
  LINE (LBLD+577,BLAD+239,BLAD+241)
  LINE (LBLD+578,BLAD+240,BLAD+242)
  LINE (LBLD+579,BLAD+197,BLAD+241)
(*
  LINE (LBLD+580,BLAD+200,BLAD+242)
  LINE (LBLD+581,BLAD+241,BLAD+242)
  ARCCF(LBLD+582,BLAD+241,BLAD+243,937)
  ARCCF(LBLD+583,BLAD+242,BLAD+244,909)
  LINE (LBLD+584,BLAD+201,BLAD+243)
  LINE (LBLD+585,BLAD+202,BLAD+244)
```

```
  LINE (LBLD+586.BLAD+243.BLAD+244)
(*
  LINE (LBLD+816.BLAD+203.BLAD+205)
  LINE (LBLD+817.BLAD+204.BLAD+206)
  LINE (LBLD+818.BLAD+194.BLAD+236)
(*
(* DELETE TEMPORARY POINTS THAT WERE CONSTRUCTED
(*
  DELETEPT (900)
  DELETEPT (901)
  DELETEPT (902)
  DELETEPT (903)
  DELETEPT (904)
  DELETEPT (905)
  DELETEPT (906)
  DELETEPT (907)
  DELETEPT (908)
  DELETEPT (909)
(*
  DELETEPT (910)
  DELETEPT (911)
  DELETEPT (912)
  DELETEPT (913)
  DELETEPT (914)
  DELETEPT (915)
  DELETEPT (916)
  DELETEPT (917)
  DELETEPT (918)
  DELETEPT (919)
(*
  DELETEPT (920)
  DELETEPT (921)
  DELETEPT (922)
  DELETEPT (923)
  DELETEPT (924)
  DELETEPT (925)
  DELETEPT (926)
  DELETEPT (927)
  DELETEPT (928)
  DELETEPT (929)
(*
  DELETEPT (930)
  DELETEPT (931)
  DELETEPT (932)
  DELETEPT (933)
  DELETEPT (934)
  DELETEPT (935)
  DELETEPT (936)
  DELETEPT (937)
(*
(***************************************************************
(*                                                             *
(*                - BLADE SURFACE DEFINITIONS -                *
```

```
(*                         DEFINE ESMOSS SURFACES                          *
(*                                                                         *
(***************************************************************************
(*
(*
(* SURFACES FOR REGION 93
(*
  RULEDSRF (SBLD+430,LBLD+368,LBLD+816)
  RULEDSRF (SBLD+431,LBLD+370,LBLD+481)
  RULEDSRF (SBLD+432,LBLD+369,LBLD+817)
  RULEDSRF (SBLD+433,LBLD+365,LBLD+478)
  RULEDSRF (SBLD+434,LBLD+481,LBLD+478)
(*
(* SURFACES FOR REGION 94
(*
  RULEDSRF (SBLD+435,LBLD+373,LBLD+483)
  RULEDSRF (SBLD+436,LBLD+390,LBLD+488)
  RULEDSRF (SBLD+437,LBLD+376,LBLD+484)
  RULEDSRF (SBLD+438,LBLD+483,LBLD+484)
(*
(* SURFACES FOR REGION 95
(*
  RULEDSRF (SBLD+439,LBLD+381,LBLD+494)
  RULEDSRF (SBLD+440,LBLD+393,LBLD+499)
  RULEDSRF (SBLD+441,LBLD+382,LBLD+495)
  RULEDSRF (SBLD+442,LBLD+494,LBLD+495)
(*
(* SURFACES FOR REGION 96
(*
  RULEDSRF (SBLD+443,LBLD+396,LBLD+505)
  RULEDSRF (SBLD+444,LBLD+401,LBLD+510)
  RULEDSRF (SBLD+445,LBLD+397,LBLD+506)
  RULEDSRF (SBLD+446,LBLD+505,LBLD+506)
(*
(* SURFACES FOR REGION 97
(*
  RULEDSRF (SBLD+447,LBLD+406,LBLD+516)
  RULEDSRF (SBLD+448,LBLD+411,LBLD+521)
  RULEDSRF (SBLD+449,LBLD+407,LBLD+517)
  RULEDSRF (SBLD+450,LBLD+516,LBLD+517)
(*
(* SURFACES FOR REGION 98
(*
  RULEDSRF (SBLD+451,LBLD+417,LBLD+527)
  RULEDSRF (SBLD+452,LBLD+422,LBLD+532)
  RULEDSRF (SBLD+453,LBLD+418,LBLD+528)
  RULEDSRF (SBLD+454,LBLD+527,LBLD+528)
(*
(* SURFACES FOR REGION 99
(*
  RULEDSRF (SBLD+455,LBLD+428,LBLD+538)
  RULEDSRF (SBLD+456,LBLD+433,LBLD+543)
  RULEDSRF (SBLD+457,LBLD+429,LBLD+539)
```

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RULEDSRF (SBLD+458.LBLD+538.LBLD+539)
(*
(* SURFACES FOR REGION 100
(*
 RULEDSRF (SBLD+459.LBLD+439.LBLD+549)
 RULEDSRF (SBLD+460.LBLD+444.LBLD+554)
 RULEDSRF (SBLD+461.LBLD+440.LBLD+550)
 RULEDSRF (SBLD+462.LBLD+549.LBLD+550)
(*
(* SURFACES FOR REGION 101
(*
 RULEDSRF (SBLD+463.LBLD+450.LBLD+560)
 RULEDSRF (SBLD+464.LBLD+455.LBLD+565)
 RULEDSRF (SBLD+465.LBLD+451.LBLD+561)
 RULEDSRF (SBLD+466.LBLD+560.LBLD+561)
(*
(* SURFACES FOR REGION 102
(*
 RULEDSRF (SBLD+467.LBLD+461.LBLD+570)
 RULEDSRF (SBLD+468.LBLD+466.LBLD+577)
 RULEDSRF (SBLD+469.LBLD+462.LBLD+571)
 RULEDSRF (SBLD+470.LBLD+570.LBLD+571)
(*
(* SURFACES FOR REGION 103
(*
 RULEDSRF (SBLD+471.LBLD+391.LBLD+490)
 RULEDSRF (SBLD+472.LBLD+394.LBLD+501)
 RULEDSRF (SBLD+473.LBLD+383.LBLD+496)
 RULEDSRF (SBLD+474.LBLD+490.LBLD+501)
(*
(* SURFACES FOR REGION 104
(*
 RULEDSRF (SBLD+475.LBLD+413.LBLD+523)
 RULEDSRF (SBLD+476.LBLD+408.LBLD+518)
 RULEDSRF (SBLD+477.LBLD+402.LBLD+512)
 RULEDSRF (SBLD+478.LBLD+517.LBLD+518)
(*
(* SURFACES FOR REGION 105
(*
 RULEDSRF (SBLD+479.LBLD+435.LBLD+545)
 RULEDSRF (SBLD+480.LBLD+430.LBLD+540)
 RULEDSRF (SBLD+481.LBLD+424.LBLD+534)
 RULEDSRF (SBLD+482.LBLD+539.LBLD+540)
(*
(* SURFACES FOR REGION 106
(*
 RULEDSRF (SBLD+483.LBLD+457.LBLD+566)
 RULEDSRF (SBLD+484.LBLD+452.LBLD+562)
 RULEDSRF (SBLD+485.LBLD+446.LBLD+556)
 RULEDSRF (SBLD+486.LBLD+561.LBLD+562)
(*
(* SURFACES FOR REGION 107
(*
```

```
  RULEDSRF  (SBLD+487,LBLD+377,LBLD+485)
  RULEDSRF  (SBLD+488,LBLD+392,LBLD+492)
  RULEDSRF  (SBLD+489,LBLD+380,LBLD+486)
  RULEDSRF  (SBLD+490,LBLD+485,LBLD+486)
(*
(* SURFACES FOR REGION 108
(*
  RULEDSRF  (SBLD+491,LBLD+395,LBLD+503)
  RULEDSRF  (SBLD+492,LBLD+384,LBLD+497)
  RULEDSRF  (SBLD+493,LBLD+496,LBLD+497)
(*
(* SURFACES FOR REGION 109
(*
  RULEDSRF  (SBLD+495,LBLD+404,LBLD+514)
  RULEDSRF  (SBLD+496,LBLD+399,LBLD+508)
  RULEDSRF  (SBLD+497,LBLD+398,LBLD+507)
  RULEDSRF  (SBLD+498,LBLD+507,LBLD+508)
(*
(* SURFACES FOR REGION 110
(*
  RULEDSRF  (SBLD+499,LBLD+415,LBLD+525)
  RULEDSRF  (SBLD+500,LBLD+409,LBLD+519)
  RULEDSRF  (SBLD+501,LBLD+518,LBLD+519)
(*
(* SURFACES FOR REGION 111
(*
  RULEDSRF  (SBLD+502,LBLD+419,LBLD+529)
  RULEDSRF  (SBLD+503,LBLD+426,LBLD+536)
  RULEDSRF  (SBLD+504,LBLD+420,LBLD+530)
  RULEDSRF  (SBLD+505,LBLD+529,LBLD+530)
(*
(* SURFACES FOR REGION 112
(*
  RULEDSRF  (SBLD+506,LBLD+437,LBLD+547)
  RULEDSRF  (SBLD+507,LBLD+431,LBLD+541)
  RULEDSRF  (SBLD+508,LBLD+540,LBLD+541)
(*
(* SURFACES FOR REGION 113
(*
  RULEDSRF  (SBLD+509,LBLD+441,LBLD+551)
  RULEDSRF  (SBLD+510,LBLD+448,LBLD+558)
  RULEDSRF  (SBLD+511,LBLD+442,LBLD+552)
  RULEDSRF  (SBLD+512,LBLD+551,LBLD+552)
(*
(* SURFACES FOR REGION 114
(*
  RULEDSRF  (SBLD+513,LBLD+459,LBLD+568)
  RULEDSRF  (SBLD+514,LBLD+453,LBLD+563)
  RULEDSRF  (SBLD+515,LBLD+562,LBLD+563)
(*
(* SURFACES FOR REGION 115
(*
  RULEDSRF  (SBLD+516,LBLD+463,LBLD+572)
```

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  RULEDSRF (SBLD+517,LBLD+469,LBLD+578)
  RULEDSRF (SBLD+518,LBLD+464,LBLD+573)
  RULEDSRF (SBLD+519,LBLD+572,LBLD+573)
(*
(* SURFACES FOR REGION 116
(*
  RULEDSRF (SBLD+520,LBLD+815,LBLD+576)
  RULEDSRF (SBLD+521,LBLD+471,LBLD+581)
  RULEDSRF (SBLD+522,LBLD+576,LBLD+581)
(*
(* SURFACES FOR REGION 117
(*
  RULEDSRF (SBLD+523,LBLD+472,LBLD+582)
  RULEDSRF (SBLD+524,LBLD+476,LBLD+586)
  RULEDSRF (SBLD+525,LBLD+473,LBLD+583)
  RULEDSRF (SBLD+526,LBLD+582,LBLD+583)
(*
(*****************************************************************
(*                                                               *
(*                                                               *
(*                 - BLADE REGION DEFINITIONS -                  *
(*                    DEFINE ESMOSS REGIONS                      *
(*                                                               *
(*****************************************************************
(*
(*               DEFINE REGION 93
(*
  REG3D (93,SBLD+430,SBLD+431,SBLD+432,SBLD+433,SBLD+434,SBLD+650, &
        LBLD+368,LBLD+370,LBLD+369,LBLD+365,LBLD+816,LBLD+481, &
        LBLD+817,LBLD+478,LBLD+477,LBLD+480,LBLD+482,LBLD+479, &
        BLAD+161,BLAD+162,BLAD+163,BLAD+164,BLAD+203,BLAD+204, &
        BLAD+205,BLAD+206)
(*
(*               DEFINE REGION 94
(*
  REG3D (94,SBLD+430,SBLD+435,SBLD+436,SBLD+437,SBLD+438,SBLD+339, &
        LBLD+373,LBLD+390,LBLD+376,LBLD+368,LBLD+483,LBLD+488, &
        LBLD+484,LBLD+816,LBLD+487,LBLD+489,LBLD+480,LBLD+477, &
        BLAD+161,BLAD+163,BLAD+165,BLAD+166,BLAD+203,BLAD+205, &
        BLAD+207,BLAD+208)
(*
(*               DEFINE REGION 95
(*
  REG3D (95,SBLD+439,SBLD+440,SBLD+441,SBLD+442,SBLD+343,SBLD+436, &
        LBLD+381,LBLD+393,LBLD+382,LBLD+390,LBLD+494,LBLD+499, &
        LBLD+495,LBLD+488,LBLD+487,LBLD+498,LBLD+500,LBLD+489, &
        BLAD+165,BLAD+166,BLAD+169,BLAD+170,BLAD+207,BLAD+208, &
        BLAD+211,BLAD+212)
(*
(*               DEFINE REGION 96
(*
  REG3D (96,SBLD+440,SBLD+443,SBLD+444,SBLD+445,SBLD+446,SBLD+347, &
        LBLD+396,LBLD+401,LBLD+397,LBLD+393,LBLD+505,LBLD+510, &
        LBLD+506,LBLD+499,LBLD+498,LBLD+509,LBLD+511,LBLD+500, &
```

```
        BLAD+169,BLAD+170,BLAD+173,BLAD+174,BLAD+211,BLAD+212, &
        BLAD+215,BLAD+216)
(*
(*             DEFINE REGION 97
(*
 REG3D (97,SBLD+444,SBLD+447,SBLD+448,SBLD+449,SBLD+450,SBLD+351, &
        LBLD+406,LBLD+411,LBLD+407,LBLD+401,LBLD+516,LBLD+521, &
        LBLD+517,LBLD+510,LBLD+509,LBLD+520,LBLD+522,LBLD+511, &
        BLAD+173,BLAD+174,BLAD+177,BLAD+178,BLAD+215,BLAD+216, &
        BLAD+219,BLAD+220)
(*
(*             DEFINE REGION 98
(*
 REG3D (98,SBLD+448,SBLD+451,SBLD+452,SBLD+453,SBLD+454,SBLD+355, &
        LBLD+417,LBLD+422,LBLD+418,LBLD+411,LBLD+527,LBLD+532, &
        LBLD+528,LBLD+521,LBLD+520,LBLD+531,LBLD+533,LBLD+522, &
        BLAD+177,BLAD+178,BLAD+181,BLAD+182,BLAD+219,BLAD+220, &
        BLAD+223,BLAD+224)
(*
(*             DEFINE REGION 99
(*
 REG3D (99,SBLD+452,SBLD+455,SBLD+456,SBLD+457,SBLD+458,SBLD+359, &
        LBLD+428,LBLD+433,LBLD+429,LBLD+422,LBLD+538,LBLD+543, &
        LBLD+539,LBLD+532,LBLD+531,LBLD+542,LBLD+544,LBLD+533, &
        BLAD+181,BLAD+182,BLAD+185,BLAD+186,BLAD+223,BLAD+224, &
        BLAD+227,BLAD+228)
(*
(*             DEFINE REGION 100
(*
 REG3D(100,SBLD+456,SBLD+459,SBLD+460,SBLD+461,SBLD+462,SBLD+363, &
        LBLD+439,LBLD+444,LBLD+440,LBLD+433,LBLD+549,LBLD+554, &
        LBLD+550,LBLD+543,LBLD+542,LBLD+553,LBLD+555,LBLD+544, &
        BLAD+185,BLAD+186,BLAD+189,BLAD+190,BLAD+227,BLAD+228, &
        BLAD+231,BLAD+232)
(*
(*             DEFINE REGION 101
(*
 REG3D(101,SBLD+460,SBLD+463,SBLD+464,SBLD+465,SBLD+466,SBLD+367, &
        LBLD+450,LBLD+455,LBLD+451,LBLD+444,LBLD+560,LBLD+565, &
        LBLD+561,LBLD+554,LBLD+553,LBLD+564,LBLD+818,LBLD+555, &
        BLAD+189,BLAD+190,BLAD+193,BLAD+194,BLAD+231,BLAD+232, &
        BLAD+235,BLAD+236)
(*
(*             DEFINE REGION 102
(*
 REG3D(102,SBLD+464,SBLD+467,SBLD+468,SBLD+469,SBLD+470,SBLD+371, &
        LBLD+461,LBLD+466,LBLD+462,LBLD+455,LBLD+570,LBLD+577, &
        LBLD+571,LBLD+565,LBLD+564,LBLD+579,LBLD+574,LBLD+818, &
        BLAD+193,BLAD+194,BLAD+197,BLAD+198,BLAD+235,BLAD+236, &
        BLAD+241,BLAD+239)
(*
(*             DEFINE REGION 103
(*
```

```
REG3D(103,SBLD+441,SBLD+471,SBLD+472,SBLD+473,SBLD+474,SBLD+375, &
        LBLD+382,LBLD+394,LBLD+383,LBLD+391,LBLD+495,LBLD+501, &
        LBLD+496,LBLD+490,LBLD+489,LBLD+500,LBLD+502,LBLD+491, &
        BLAD+166,BLAD+167,BLAD+170,BLAD+171,BLAD+208,BLAD+209, &
        BLAD+212,BLAD+213)
(*
(*            DEFINE REGION 104
(*
REG3D(104,SBLD+449,SBLD+475,SBLD+476,SBLD+477,SBLD+478,SBLD+379, &
        LBLD+407,LBLD+413,LBLD+408,LBLD+402,LBLD+517,LBLD+523, &
        LBLD+518,LBLD+512,LBLD+511,LBLD+522,LBLD+524,LBLD+513, &
        BLAD+174,BLAD+175,BLAD+178,BLAD+179,BLAD+216,BLAD+217, &
        BLAD+220,BLAD+221)
(*
(*            DEFINE REGION 105
(*
REG3D(105,SBLD+457,SBLD+479,SBLD+480,SBLD+481,SBLD+482,SBLD+383, &
        LBLD+429,LBLD+435,LBLD+430,LBLD+424,LBLD+539,LBLD+545, &
        LBLD+540,LBLD+534,LBLD+533,LBLD+544,LBLD+546,LBLD+535, &
        BLAD+182,BLAD+183,BLAD+186,BLAD+187,BLAD+224,BLAD+225, &
        BLAD+228,BLAD+229)
(*
(*            DEFINE REGION 106
(*
REG3D(106,SBLD+465,SBLD+483,SBLD+484,SBLD+485,SBLD+486,SBLD+387, &
        LBLD+451,LBLD+457,LBLD+452,LBLD+446,LBLD+561,LBLD+566, &
        LBLD+562,LBLD+556,LBLD+555,LBLD+818,LBLD+567,LBLD+557, &
        BLAD+190,BLAD+191,BLAD+194,BLAD+195,BLAD+232,BLAD+233, &
        BLAD+236,BLAD+237)
(*
(*            DEFINE REGION 107
(*
REG3D(107,SBLD+432,SBLD+487,SBLD+488,SBLD+489,SBLD+490,SBLD+391, &
        LBLD+377,LBLD+392,LBLD+380,LBLD+369,LBLD+485,LBLD+492, &
        LBLD+486,LBLD+817,LBLD+482,LBLD+491,LBLD+493,LBLD+479, &
        BLAD+164,BLAD+162,BLAD+167,BLAD+168,BLAD+204,BLAD+206, &
        BLAD+209,BLAD+210)
(*
(*            DEFINE REGION 108
(*
REG3D(108,SBLD+488,SBLD+473,SBLD+491,SBLD+492,SBLD+493,SBLD+394, &
        LBLD+383,LBLD+395,LBLD+384,LBLD+392,LBLD+496,LBLD+503, &
        LBLD+497,LBLD+492,LBLD+491,LBLD+502,LBLD+504,LBLD+493, &
        BLAD+167,BLAD+168,BLAD+171,BLAD+172,BLAD+209,BLAD+210, &
        BLAD+213,BLAD+214)
(*
(*            DEFINE REGION 109
(*
REG3D(109,SBLD+491,SBLD+495,SBLD+496,SBLD+497,SBLD+498,SBLD+398, &
        LBLD+398,LBLD+404,LBLD+399,LBLD+395,LBLD+507,LBLD+514, &
        LBLD+508,LBLD+503,LBLD+502,LBLD+513,LBLD+515,LBLD+504, &
        BLAD+171,BLAD+172,BLAD+175,BLAD+176,BLAD+213,BLAD+214, &
        BLAD+217,BLAD+218)
```

```
(*
(*               DEFINE REGION 110
(*
  REG3D(110,SBLD+495,SBLD+476,SBLD+499,SBLD+500,SBLD+501,SBLD+401, &
        LBLD+408,LBLD+415,LBLD+409,LBLD+404,LBLD+518,LBLD+525, &
        LBLD+519,LBLD+514,LBLD+513,LBLD+524,LBLD+526,LBLD+515, &
        BLAD+175,BLAD+176,BLAD+179,BLAD+180,BLAD+217,BLAD+218, &
        BLAD+221,BLAD+222)
(*
(*               DEFINE REGION 111
(*
  REG3D(111,SBLD+499,SBLD+502,SBLD+503,SBLD+504,SBLD+505,SBLD+405, &
        LBLD+419,LBLD+426,LBLD+420,LBLD+415,LBLD+529,LBLD+536, &
        LBLD+530,LBLD+525,LBLD+524,LBLD+535,LBLD+537,LBLD+526, &
        BLAD+179,BLAD+180,BLAD+183,BLAD+184,BLAD+221,BLAD+222, &
        BLAD+225,BLAD+226)
(*
(*               DEFINE REGION 112
(*
  REG3D(112,SBLD+503,SBLD+480,SBLD+506,SBLD+507,SBLD+508,SBLD+408, &
        LBLD+430,LBLD+437,LBLD+431,LBLD+426,LBLD+540,LBLD+547, &
        LBLD+541,LBLD+536,LBLD+535,LBLD+546,LBLD+548,LBLD+537, &
        BLAD+183,BLAD+184,BLAD+187,BLAD+188,BLAD+225,BLAD+226, &
        BLAD+229,BLAD+230)
(*
(*               DEFINE REGION 113
(*
  REG3D(113,SBLD+506,SBLD+509,SBLD+510,SBLD+511,SBLD+512,SBLD+412, &
        LBLD+441,LBLD+448,LBLD+442,LBLD+437,LBLD+551,LBLD+558, &
        LBLD+552,LBLD+547,LBLD+546,LBLD+557,LBLD+559,LBLD+548, &
        BLAD+187,BLAD+188,BLAD+191,BLAD+192,BLAD+229,BLAD+230, &
        BLAD+233,BLAD+234)
(*
(*               DEFINE REGION 114
(*
  REG3D(114,SBLD+510,SBLD+484,SBLD+513,SBLD+514,SBLD+515,SBLD+415, &
        LBLD+452,LBLD+459,LBLD+453,LBLD+448,LBLD+562,LBLD+568, &
        LBLD+563,LBLD+558,LBLD+557,LBLD+567,LBLD+569,LBLD+559, &
        BLAD+191,BLAD+192,BLAD+195,BLAD+196,BLAD+233,BLAD+234, &
        BLAD+237,BLAD+238)
(*
(*               DEFINE REGION 115
(*
  REG3D(115,SBLD+513,SBLD+516,SBLD+517,SBLD+518,SBLD+519,SBLD+419, &
        LBLD+463,LBLD+469,LBLD+464,LBLD+459,LBLD+572,LBLD+578, &
        LBLD+573,LBLD+568,LBLD+567,LBLD+575,LBLD+580,LBLD+569, &
        BLAD+195,BLAD+196,BLAD+199,BLAD+200,BLAD+237,BLAD+238, &
        BLAD+240,BLAD+242)
(*
(*               DEFINE REGION 116
(*
  REG3D(116,SBLD+468,SBLD+517,SBLD+520,SBLD+521,SBLD+522,SBLD+422, &
        LBLD+466,LBLD+471,LBLD+469,LBLD+815,LBLD+577,LBLD+581, &
```

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        LBLD+578,LBLD+576,LBLD+574,LBLD+575,LBLD+579,LBLD+580, &
        BLAD+198,BLAD+199,BLAD+200,BLAD+197,BLAD+239,BLAD+240, &
        BLAD+241,BLAD+242)
(*
(*              DEFINE REGION 117
(*
 REG3D(117,SBLD+521,SBLD+523,SBLD+524,SBLD+525,SBLD+526,SBLD+425, &
        LBLD+471,LBLD+472,LBLD+476,LBLD+473,LBLD+582,LBLD+586, &
        LBLD+583,LBLD+581,LBLD+579,LBLD+584,LBLD+585,LBLD+580, &
        BLAD+197,BLAD+200,BLAD+201,BLAD+202,BLAD+241,BLAD+242, &
        BLAD+243,BLAD+244)
(*
```

```
(*
(*
(*
(*                    DEFINE THE PLATFORM
(*
(*
(*
(*
(*
  WOVRHANG=(PWIDTH-(DTHICK6*2))/2
  LOVRHANG=(PLENGTH-STHICK)/2
  BXVAL=-DTHICK6-WOVRHANG+FRTSHFT
  FXVAL= DTHICK6+WOVRHANG+FRTSHFT
  PLAT=0
(*
(*                DEFINE POINTS ON PLATFORM BOTTOM
(*
  POINT (PLAT+65,BXVAL,(-LOVRHANG+SIDSHFT),DRADIUS6)
  POINT (PLAT+66,(-DTHICK6+WTHICK),(2*(-LOVRHANG+SIDSHFT))/3,DRADIUS6)
  POINT (PLAT+67,(DTHICK6-WTHICK),(2*(-LOVRHANG+SIDSHFT))/3,DRADIUS6)
  POINT (PLAT+68,FXVAL,(-LOVRHANG+SIDSHFT),DRADIUS6)
  POINT (PLAT+69,-DTHICK2,(-LOVRHANG+SIDSHFT)/3,DRADIUS6)
  POINT (PLAT+70,DTHICK2, (-LOVRHANG+SIDSHFT)/3,DRADIUS6)
(*
  YCORD=0
  POINT (PLAT+71,BXVAL,YCORD,DRADIUS6)
  POINT (PLAT+72,FXVAL,YCORD,DRADIUS6)
(*
  YCORD=YCORD+RTHICK
  POINT (PLAT+73,BXVAL,YCORD,DRADIUS6)
  POINT (PLAT+74,FXVAL,YCORD,DRADIUS6)
(*
  YCORD=YCORD+HOLE
  POINT (PLAT+75,BXVAL,YCORD,DRADIUS6)
  POINT (PLAT+76,FXVAL,YCORD,DRADIUS6)
(*
  YCORD=YCORD+RTHICK
  POINT (PLAT+77,BXVAL,YCORD,DRADIUS6)
  POINT (PLAT+78,FXVAL,YCORD,DRADIUS6)
(*
  YCORD=YCORD+HOLE
  POINT (PLAT+79,BXVAL,YCORD,DRADIUS6)
  POINT (PLAT+80,FXVAL,YCORD,DRADIUS6)
(*
  YCORD=YCORD+RTHICK
  POINT (PLAT+81,BXVAL,YCORD,DRADIUS6)
  POINT (PLAT+82,FXVAL,YCORD,DRADIUS6)
(*
  YCORD=YCORD+HOLE
  POINT (PLAT+83,BXVAL,YCORD,DRADIUS6)
  POINT (PLAT+84,FXVAL,YCORD,DRADIUS6)
(*
```

```
 YCORD=YCORD+RTHICK
 POINT (PLAT+85,BXVAL.YCORD.DRADIUS6)
 POINT (PLAT+86.FXVAL.YCORD.DRADIUS6)
(*
 YTEMP=LOVRHANG+SIDSHFT
 POINT (PLAT+87.BXVAL.(STHICK+LOVRHANG+SIDSHFT) DRADIUS6)
 POINT (PLAT+88,-DTHICK6+WTHICK,YCORD+(YTEMP/2) DRADIUS6)
 POINT (PLAT+89.0.YCORD+(YTEMP/3).DRADIUS6)
(*
 POINT (PLAT+90,((2*DTHICK6-WTHICK)/2),YCORD+(YTEMP/3).DRADIUS6)
 POINT (PLAT+91,DTHICK6.YCORD+(YTEMP/2),DRADIUS6)
 POINT (PLAT+92,FXVAL.YCORD+(YTEMP/2),DRADIUS6)
 POINT (PLAT+93,DTHICK6,YCORD+(7*YTEMP/8).DRADIUS6)
 POINT (PLAT+94,((2*DTHICK6)+WOVRHANG+FRTSHFT)/2,YCORD+(5*YTEMP/8), &   IUS8)
       DRADIUS6)
 POINT (PLAT+95.FXVAL.YCORD+(3*YTEMP/4).DRADIUS6)
 POINT (PLAT+96,FXVAL,(STHICK+LOVRHANG+SIDSHFT),DRADIUS6)
(*
(*              DEFINE POINTS ON PLATFORM TOP
(*
 PRINT INPUT THE CAMBER ANGLE OF THE AIRFOIL IN DEGREES
(* READ CAMBER
 CAMBER=65
 PRINT INPUT THE MAXIMUM THICKNESS DIVIDED BY THE CHORD LENGTH
(* READ THCKCH
 THCKCH=0.9
(*
 RADCAM=RADIAN(CAMBER)
(*
 PRINT INPUT THE X AND Y POSITION OF THE TIP OF THE LEADING EDGE
(* READ XLED1,YLED1
 XLED1=1.75
 YLED1=-2
(*
 PRINT INPUT THE X AND Y POSITION OF THE TIP OF THE TRAILING EDGE
(* READ XTED1.YTED1
 XTED1=1.75
 YTED1=10.5
(*
  XK=XLED1
  YK=YLED1
  XM=XTED1
  YM=YTED1
(*
 PRINT INPUT THE RADIUS OF THE ARC
(* READ CARC1
 CARC1=11
 RK=CARC1
 CHORD=2*(SIN(RADCAM/2)*CARC1)
 THICK=CHORD*THCKCH
(*
 CNTR-PT
 XCENTER=XL
```

```
  YCENTER=YL
(*
  XINNER=XCENTER-(THICK/2)
  XOUTER=XCENTER+(THICK/2)
(*
(* NOW DEFINE THE PARAMETERS FOR THE COOLING PASSAGE CURVES
(*
  PRINT INPUT THE X AND Y POSITION OF THE TIP OF THE LEADING EDGE CAVITY
(* READ CXLED,CYLED
  CXLED=0.75
  CYLED=0.0
  PRINT INPUT THE X AND Y POSITION OF THE TIP OF THE TRAILING EDGE
  PRINT CAVITY
(* READ CXTED,CYTED
  CXTED=.75
  CYTED=9.0
(*
  XK=CXLED
  YK=CYLED
  XM=CXTED
  YM=CYTED
(*
  PRINT INPUT THE RADIUS OF THE ARC OF THE CAVITY
(* READ CARC2
  CARC2=9.5
  RK=CARC2
  SMCHRD=2*(SIN(RADCAM/2)*CARC2)
(*
  CNTR-PT
  CXCNTR=XL
  CYCNTR=YL
(*
  SMTHCK=.5*THICK
  CXINER=CXCNTR-(SMTHCK/2)
  CXOTER=CXCNTR+(SMTHCK/2)
(*
  YCORD=0
  ZVAL=DRADIUS6+PTHICK
(*
  POINT(801,XLED1,YLED1,ZVAL)
  POINT(802,XTED1,YTED1,ZVAL)
  POINT(803,CXLED,CYLED,ZVAL)
  POINT(804,CXTED,CYTED,ZVAL)
  POINT(805,XINNER,YCENTER,ZVAL)
  POINT(806,XOUTER,YCENTER,ZVAL)
  POINT(807,CXINER,CYCNTR,ZVAL)
  POINT(808,CXOTER,CYCNTR,ZVAL)
(*
  ARC(900,806,801,802)
  ARC(901,805,801,802)
  ARC(902,808,803,804)
  ARC(903,807,803,804)
(*
```

```
(* GET THE RIB POSITIONS FROM THE USER
(*
 PRINT INPUT THE FIRST RIB POSITION   THE VALUE SHOULD BE BETWEEN
 PRINT 0 AND 1 (0 = LEADING EDGE   1 = TRAILING EDGE)
(*READ POS1
 POS1=.15
(*
 PRINT INPUT THE END POSITION OF THE FIRST RIB. TO DETERMINE THE
 PRINT RIB THICKNESS
(*READ WPOS1
 WPOS1=.19
(*
 PRINT INPUT THE SECOND RIB POSITION (BETWEEN 0 AND 1)
(*READ POS2
 POS2=.30
 WPOS2=POS2+(WPOS1-POS1)
(*
 PRINT INPUT THE THIRD RIB POSITION (BETWEEN 0 AND 1)
(*READ POS3
 POS3=.50
 WPOS3=POS3+(WPOS1-POS1)
(*
 PRINT INPUT THE FOURTH RIB POSITION (BETWEEN 0 AND 1)
(*READ POS4
 POS4=.70
 WPOS4=POS4+(WPOS1-POS1)
(*
 POINT (PLAT+97.BXVAL.(-LOVRHANG+SIDSHFT).ZVAL)
 PARMCRV (PLAT+98.901, .05)
 PARMCRV (PLAT+99.900..05)
 POINT  (PLAT+100.FXVAL.(-LOVRHANG+SIDSHFT).ZVAL)
 POINT  (PLAT+101.BXVAL.YCORD.ZVAL)
 PARMCRV (PLAT+102.901.(POS1+.05))
 PARMCRV (PLAT+103.903..05)
 PARMCRV (PLAT+104.902,.05)
 PARMCRV (PLAT+105.903.POS1)
 PARMCRV (PLAT+106.902.POS1)
 PARMCRV (PLAT+107.900.(POS1+.05))
 POINT  (PLAT+108.FXVAL.YCORD.ZVAL)
(*
 YCORD=YCORD+RTHICK
 POINT  (PLAT+109.BXVAL.YCORD.ZVAL)
 PARMCRV (PLAT+110 901.(WPOS1+ 05))
 PARMCRV (PLAT+111.903.WPOS1)
 PARMCRV (PLAT+112.902.WPOS1)
 PARMCRV (PLAT+113.900.(WPOS1+.05))
 POINT  (PLAT+114.FXVAL.YCORD.ZVAL)
(*
 YCORD=YCORD+HOLE
 POINT  (PLAT+115.BXVAL.YCORD.ZVAL)
 PARMCRV (PLAT+116.901.(POS2+.05))
 PARMCRV (PLAT+117.903.POS2)
 PARMCRV (PLAT+118.902.POS2)
```

```
PARMCRV (PLAT+119,900,(POS2+.05))
POINT   (PLAT+120,FXVAL,YCORD,ZVAL)
(*
YCORD=YCORD+RTHICK
POINT   (PLAT+121,BXVAL,YCORD,ZVAL)
PARMCRV (PLAT+122,901,(WPOS2+.05))
PARMCRV (PLAT+123,903,WPOS2)
PARMCRV (PLAT+124,902,WPOS2)
PARMCRV (PLAT+125,900,(WPOS2+.05))
POINT   (PLAT+126,FXVAL,YCORD,ZVAL)
(*
YCORD=YCORD+HOLE
POINT   (PLAT+127,BXVAL,YCORD,ZVAL)
PARMCRV (PLAT+128,901,POS3)
PARMCRV (PLAT+129,903,POS3)
PARMCRV (PLAT+130,902,POS3)
PARMCRV (PLAT+131,900,POS3)
POINT   (PLAT+132,FXVAL,YCORD,ZVAL)
(*
YCORD=YCORD+RTHICK
POINT   (PLAT+133,BXVAL,YCORD,ZVAL)
PARMCRV (PLAT+134,901,WPOS3+.03)
PARMCRV (PLAT+135,903,WPOS3)
PARMCRV (PLAT+136,902,WPOS3)
PARMCRV (PLAT+137,900,WPOS3+.03)
POINT   (PLAT+138,FXVAL,YCORD,ZVAL)
(*
YCORD=YCORD+HOLE
POINT   (PLAT+139,BXVAL,YCORD,ZVAL)
PARMCRV (PLAT+140,901,(POS4-.05))
PARMCRV (PLAT+141,903,POS4)
PARMCRV (PLAT+142,902,POS4)
PARMCRV (PLAT+143,900,(POS4-.05))
POINT   (PLAT+144,FXVAL,YCORD,ZVAL)
(*
YCORD=YCORD+RTHICK
POINT   (PLAT+145,BXVAL,YCORD,ZVAL)
PARMCRV (PLAT+146,901,(WPOS4-.05))
PARMCRV (PLAT+147,903,WPOS4)
PARMCRV (PLAT+148,902,WPOS4)
PARMCRV (PLAT+149,900,(WPOS4-.05))
(*
POINT   (PLAT+150,FXVAL,YCORD,ZVAL)
POINT   (PLAT+151,BXVAL,STHICK+LOVRHANG+SIDSHFT,ZVAL)
PARMCRV (PLAT+152,901,.90)
PARMCRV (PLAT+153,903,.90)
PARMCRV (PLAT+154,902,.90)
PARMCRV (PLAT+155,900,.90)
POINT   (PLAT+156,FXVAL,YCORD+(YTEMP/2),ZVAL)
PARMCRV (PLAT+157,901,.97)
PARMCRV (PLAT+158,900,.97)
POINT   (PLAT+159,FXVAL,YCORD+(3*YTEMP/4),ZVAL)
POINT   (PLAT+160,FXVAL,(STHICK+LOVRHANG+SIDSHFT),ZVAL)
```

```
(*
(* CONSTRUCT TEMPORARY POINTS NEEDED TO DEFINE CURVES
(*
  PARMCRV (900,900,(POS1/2))
  PARMCRV (901,900,(POS1+WPOS1+.1)/2)
  PARMCRV (902,900,(WPOS1+POS2+.1)/2)
  PARMCRV (903,900,(POS2+WPOS2+.1)/2)
  PARMCRV (904,900,(WPOS2+POS3+.05)/2)
  PARMCRV (905,900,(POS3+WPOS3)/2)
  PARMCRV (906,900,(WPOS3+POS4-.05)/2)
  PARMCRV (907,900,(POS4+WPOS4-.1)/2)
  PARMCRV (908,900,(WPOS4+.90)/2)
  PARMCRV (909,900,.935)
(*
  PARMCRV (910,902,(POS1/2))
  PARMCRV (911,902,(POS1+WPOS1)/2)
  PARMCRV (912,902,(WPOS1+POS2)/2)
  PARMCRV (913,902,(POS2+WPOS2)/2)
  PARMCRV (914,902,(WPOS2+POS3)/2)
  PARMCRV (915,902,(POS3+WPOS3)/2)
  PARMCRV (916,902,(WPOS3+POS4)/2)
  PARMCRV (917,902,(POS4+WPOS4)/2)
  PARMCRV (918,902,(WPOS4+.97)/2)
(*
  PARMCRV (919,903,(POS1/2))
  PARMCRV (920,903,(POS1+WPOS1)/2)
  PARMCRV (921,903,(WPOS1+POS2)/2)
  PARMCRV (922,903,(POS2+WPOS2)/2)
  PARMCRV (923,903,(WPOS2+POS3)/2)
  PARMCRV (924,903,(POS3+WPOS3)/2)
  PARMCRV (925,903,(WPOS3+POS4)/2)
  PARMCRV (926,903,(POS4+WPOS4)/2)
  PARMCRV (927,903,(WPOS4+.97)/2)
(*
  PARMCRV (928,901,(POS1/2))
  PARMCRV (929,901,(POS1+WPOS1+.1)/2)
  PARMCRV (930,901,(WPOS1+POS2+.1)/2)
  PARMCRV (931,901,(POS2+WPOS2+.1)/2)
  PARMCRV (932,901,(WPOS2+POS3+.05)/2)
  PARMCRV (933,901,(POS3+WPOS3)/2)
  PARMCRV (934,901,(WPOS3+POS4-.05)/2)
  PARMCRV (935,901,(POS4+WPOS4-.1)/2)
  PARMCRV (936,901,(WPOS4+.90)/2)
  PARMCRV (937,901,.935)
(*
(*
(*******************************************************************
(*                                                                 *
(*              - PLATFORM CURVE DEFINITIONS -                     *
(*                  DEFINE ESMOSS CURVES                           *
(*                                                                 *
(*******************************************************************
(*
```

```
(*      DEFINE CURVES ON PLATFORM BOTTOM
(*
  LINE (PLAT+137,PLAT+65,PLAT+68)
  LINE (PLAT+138,PLAT+65,PLAT+66)
  LINE (PLAT+139,PLAT+66,PLAT+67)
(*
  LINE (PLAT+140,PLAT+67,PLAT+68)
  LINE (PLAT+141,PLAT+65,PLAT+71)
  LINE (PLAT+142,PLAT+66,PLAT+4)
  LINE (PLAT+143,PLAT+69,PLAT+34)
  LINE (PLAT+144,PLAT+66,PLAT+69)
  LINE (PLAT+145,PLAT+69,PLAT+70)
  LINE (PLAT+146,PLAT+70,PLAT+36)
  LINE (PLAT+147,PLAT+67,PLAT+70)
  LINE (PLAT+148,PLAT+67,PLAT+2)
  LINE (PLAT+149,PLAT+68,PLAT+72)
(*
  LINE (PLAT+150,PLAT+71,PLAT+4)
  LINE (PLAT+151,PLAT+71,PLAT+73)
  LINE (PLAT+152,PLAT+73,PLAT+8)
  LINE (PLAT+153,PLAT+2 ,PLAT+72)
  LINE (PLAT+154,PLAT+6 ,PLAT+74)
  LINE (PLAT+155,PLAT+72,PLAT+74)
  LINE (PLAT+156,PLAT+73,PLAT+75)
  LINE (PLAT+157,PLAT+75,PLAT+12)
  LINE (PLAT+158,PLAT+10,PLAT+76)
  LINE (PLAT+159,PLAT+74,PLAT+76)
(*
  LINE (PLAT+160,PLAT+75,PLAT+77)
  LINE (PLAT+161,PLAT+77,PLAT+16)
  LINE (PLAT+162,PLAT+14,PLAT+78)
  LINE (PLAT+163,PLAT+76,PLAT+78)
  LINE (PLAT+164,PLAT+77,PLAT+79)
  LINE (PLAT+165,PLAT+79,PLAT+20)
  LINE (PLAT+166,PLAT+18,PLAT+80)
  LINE (PLAT+167,PLAT+78,PLAT+80)
  LINE (PLAT+168,PLAT+79,PLAT+81)
  LINE (PLAT+169,PLAT+81,PLAT+24)
(*
  LINE (PLAT+170,PLAT+22,PLAT+82)
  LINE (PLAT+171,PLAT+80,PLAT+82)
  LINE (PLAT+172,PLAT+81,PLAT+83)
  LINE (PLAT+173,PLAT+83,PLAT+28)
  LINE (PLAT+174,PLAT+26,PLAT+84)
  LINE (PLAT+175,PLAT+82,PLAT+84)
  LINE (PLAT+176,PLAT+83,PLAT+85)
  LINE (PLAT+177,PLAT+85,PLAT+32)
  LINE (PLAT+178,PLAT+30,PLAT+86)
  LINE (PLAT+179,PLAT+84,PLAT+86)
(*
  LINE (PLAT+180,PLAT+85,PLAT+87)
  LINE (PLAT+181,PLAT+87,PLAT+88)
  LINE (PLAT+182,PLAT+32,PLAT+88)
```

```
LINE (PLAT+183,PLAT+89,PLAT+88)
LINE (PLAT+184,PLAT+62,PLAT+89)
LINE (PLAT+185,PLAT+89,PLAT+90)
LINE (PLAT+186,PLAT+64,PLAT+90)
LINE (PLAT+187,PLAT+90,PLAT+91)
LINE (PLAT+188,PLAT+30,PLAT+91)
LINE (PLAT+189,PLAT+91,PLAT+92)
(*
LINE (PLAT+190,PLAT+86,PLAT+92)
LINE (PLAT+191,PLAT+88,PLAT+91)
LINE (PLAT+192,PLAT+88,PLAT+93)
LINE (PLAT+193,PLAT+87,PLAT+96)
LINE (PLAT+194,PLAT+91,PLAT+94)
LINE (PLAT+195,PLAT+94,PLAT+95)
LINE (PLAT+196,PLAT+92,PLAT+95)
LINE (PLAT+197,PLAT+93,PLAT+96)
LINE (PLAT+198,PLAT+95,PLAT+96)
LINE (PLAT+199,PLAT+93,PLAT+94)
(*
(*      DEFINE CURVES ON PLATFORM TOP AND CONNECTION LINES TO BOTTOM
(*
LINE (PLAT+200,PLAT+97,PLAT+100)
LINE (PLAT+201,PLAT+65,PLAT+97)
LINE (PLAT+202,PLAT+97,PLAT+98)
LINE (PLAT+203,PLAT+98,PLAT+99)
LINE (PLAT+204,PLAT+66,PLAT+98)
LINE (PLAT+205,PLAT+67,PLAT+99)
LINE (PLAT+206,PLAT+99,PLAT+100)
LINE (PLAT+207,PLAT+68,PLAT+100)
LINE (PLAT+208,PLAT+97,PLAT+101)
LINE (PLAT+209,PLAT+71,PLAT+101)
(*
LINE (PLAT+210,PLAT+101,PLAT+102)
LINE (PLAT+211,PLAT+4  ,PLAT+102)
ARCCF(PLAT+212,PLAT+98,PLAT+102,928)
LINE (PLAT+213,PLAT+34,PLAT+105)
LINE (PLAT+214,PLAT+103,PLAT+105)
LINE (PLAT+215,PLAT+98,PLAT+103)
LINE (PLAT+216,PLAT+69,PLAT+103)
LINE (PLAT+217,PLAT+70,PLAT+104)
LINE (PLAT+218,PLAT+99,PLAT+104)
LINE (PLAT+219,PLAT+104,PLAT+106)
(*
LINE (PLAT+220,PLAT+36  ,PLAT+106)
ARCCF(PLAT+221,PLAT+99,PLAT+107,900)
LINE (PLAT+222,PLAT+100,PLAT+108)
LINE (PLAT+223,PLAT+2  ,PLAT+107)
LINE (PLAT+224,PLAT+107,PLAT+108)
LINE (PLAT+225,PLAT+72,PLAT+108)
LINE (PLAT+226,PLAT+73,PLAT+109)
LINE (PLAT+227,PLAT+109,PLAT+110)
LINE (PLAT+228,PLAT+8, PLAT+110)
LINE (PLAT+229,PLAT+38,PLAT+111)
```

```
(*
  LINE (PLAT+230.PLAT+111.PLAT+112)
  LINE (PLAT+231.PLAT+40.PLAT+112)
  LINE (PLAT+232.PLAT+6   .PLAT+113)
  LINE (PLAT+233.PLAT+113.PLAT+114)
  LINE (PLAT+234.PLAT+74  .PLAT+114)
  LINE (PLAT+235.PLAT+101.PLAT+109)
  LINE (PLAT+236.PLAT+102.PLAT+110)
  LINE (PLAT+237.PLAT+105,PLAT+111)
  LINE (PLAT+238.PLAT+106.PLAT+112)
  LINE (PLAT+239.PLAT+107.PLAT+113)
(*
  LINE (PLAT+240.PLAT+108.PLAT+114)
  LINE (PLAT+241.PLAT+109.PLAT+115)
  ARCCF(PLAT+242.PLAT+110.PLAT+116.930)
  ARCCF(PLAT+243.PLAT+111.PLAT+117.921)
  ARCCF(PLAT+244.PLAT+112.PLAT+118.912)
  ARCCF(PLAT+245.PLAT+113.PLAT+119.902)
  LINE (PLAT+246.PLAT+114.PLAT+120)
  LINE (PLAT+247.PLAT+75.PLAT+115)
  LINE (PLAT+248.PLAT+12.PLAT+116)
  LINE (PLAT+249.PLAT+115.PLAT+116)
(*
  LINE (PLAT+250.PLAT+116.PLAT+117)
  LINE (PLAT+251.PLAT+42  .PLAT+117)
  LINE (PLAT+252.PLAT+117.PLAT+118)
  LINE (PLAT+253.PLAT+44.PLAT+118)
  LINE (PLAT+254.PLAT+118.PLAT+119)
  LINE (PLAT+255.PLAT+10.PLAT+119)
  LINE (PLAT+256.PLAT+119.PLAT+120)
  LINE (PLAT+257.PLAT+76.PLAT+120)
  LINE (PLAT+258.PLAT+115.PLAT+121)
  LINE (PLAT+259.PLAT+116.PLAT+122)
(*
  LINE (PLAT+260.PLAT+117.PLAT+123)
  LINE (PLAT+261.PLAT+118.PLAT+124)
  LINE (PLAT+262.PLAT+119.PLAT+125)
  LINE (PLAT+263.PLAT+120.PLAT+126)
  LINE (PLAT+264.PLAT+77  .PLAT+121)
  LINE (PLAT+265.PLAT+121.PLAT+122)
  LINE (PLAT+266.PLAT+16  .PLAT+122)
  LINE (PLAT+267.PLAT+122.PLAT+123)
  LINE (PLAT+268.PLAT+46  .PLAT+123)
  LINE (PLAT+269.PLAT+123.PLAT+124)
(*
  LINE (PLAT+270.PLAT+48  .PLAT+124)
  LINE (PLAT+271.PLAT+124.PLAT+125)
  LINE (PLAT+272.PLAT+14  .PLAT+125)
  LINE (PLAT+273.PLAT+125.PLAT+126)
  LINE (PLAT+274.PLAT+78  .PLAT+126)
  LINE (PLAT+275.PLAT+121.PLAT+127)
  ARCCF(PLAT+276.PLAT+122.PLAT+128.932)
  ARCCF(PLAT+277.PLAT+123.PLAT+129.923)
```

```
 ARCCF(PLAT+278,PLAT+124,PLAT+130,914)
 ARCCF(PLAT+279,PLAT+125,PLAT+131,904)
(*
 LINE (PLAT+280,PLAT+126,PLAT+132)
 LINE (PLAT+281,PLAT+79 ,PLAT+127)
 LINE (PLAT+282,PLAT+127,PLAT+128)
 LINE (PLAT+283,PLAT+20 ,PLAT+128)
 LINE (PLAT+284,PLAT+128,PLAT+129)
 LINE (PLAT+285,PLAT+50 ,PLAT+129)
 LINE (PLAT+286,PLAT+129,PLAT+130)
 LINE (PLAT+287,PLAT+52 ,PLAT+130)
 LINE (PLAT+288,PLAT+130,PLAT+131)
 LINE (PLAT+289,PLAT+18 ,PLAT+131)
(*
 LINE (PLAT+290,PLAT+131,PLAT+132)
 LINE (PLAT+291,PLAT+80 ,PLAT+132)
 LINE (PLAT+292,PLAT+127,PLAT+133)
 LINE (PLAT+293,PLAT+128,PLAT+134)
 LINE (PLAT+294,PLAT+129,PLAT+135)
 LINE (PLAT+295,PLAT+130,PLAT+136)
 LINE (PLAT+296,PLAT+131,PLAT+137)
 LINE (PLAT+297,PLAT+132,PLAT+138)
 LINE (PLAT+298,PLAT+81 ,PLAT+133)
 LINE (PLAT+299,PLAT+133,PLAT+134)
(*
 LINE (PLAT+300,PLAT+24 ,PLAT+134)
 LINE (PLAT+301,PLAT+134,PLAT+135)
 LINE (PLAT+302,PLAT+54 ,PLAT+135)
 LINE (PLAT+303,PLAT+135,PLAT+136)
 LINE (PLAT+304,PLAT+56 ,PLAT+136)
 LINE (PLAT+305,PLAT+136,PLAT+137)
 LINE (PLAT+306,PLAT+22 ,PLAT+137)
 LINE (PLAT+307,PLAT+137,PLAT+138)
 LINE (PLAT+308,PLAT+82 ,PLAT+138)
 LINE (PLAT+309,PLAT+133,PLAT+139)
(*
 ARCCF(PLAT+310,PLAT+134,PLAT+140,934)
 ARCCF(PLAT+311,PLAT+135,PLAT+141,925)
 ARCCF(PLAT+312,PLAT+136,PLAT+142,916)
 ARCCF(PLAT+313,PLAT+137,PLAT+143,906)
 LINE (PLAT+314,PLAT+138,PLAT+144)
 LINE (PLAT+315,PLAT+83 ,PLAT+139)
 LINE (PLAT+316,PLAT+139,PLAT+140)
 LINE (PLAT+317,PLAT+28 ,PLAT+140)
 LINE (PLAT+318,PLAT+140,PLAT+141)
 LINE (PLAT+319,PLAT+58 ,PLAT+141)
(*
 LINE (PLAT+320,PLAT+141,PLAT+142)
 LINE (PLAT+321,PLAT+60 ,PLAT+142)
 LINE (PLAT+322,PLAT+142,PLAT+143)
 LINE (PLAT+323,PLAT+26 ,PLAT+143)
 LINE (PLAT+324,PLAT+143,PLAT+144)
 LINE (PLAT+325,PLAT+84 ,PLAT+144)
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  LINE (PLAT+326,PLAT+85 ,PLAT+145)
  LINE (PLAT+327,PLAT+145,PLAT+146)
  LINE (PLAT+328,PLAT+32 ,PLAT+146)
  LINE (PLAT+329,PLAT+146,PLAT+147)
(*
  LINE (PLAT+330,PLAT+62 ,PLAT+147)
  LINE (PLAT+331,PLAT+147,PLAT+148)
  LINE (PLAT+332,PLAT+64 ,PLAT+148)
  LINE (PLAT+333,PLAT+148,PLAT+149)
  LINE (PLAT+334,PLAT+30 ,PLAT+149)
  LINE (PLAT+335,PLAT+149,PLAT+150)
  LINE (PLAT+336,PLAT+86 ,PLAT+150)
  LINE (PLAT+337,PLAT+145,PLAT+151)
  ARCCF(PLAT+338,PLAT+146,PLAT+152,936)
  ARCCF(PLAT+339,PLAT+147,PLAT+153,927)
(*
  ARCCF(PLAT+340,PLAT+148,PLAT+154,918)
  ARCCF(PLAT+341,PLAT+149,PLAT+155,908)
  LINE (PLAT+342,PLAT+150,PLAT+156)
  LINE (PLAT+343,PLAT+151,PLAT+152)
  LINE (PLAT+344,PLAT+88 ,PLAT+152)
  LINE (PLAT+345,PLAT+153,PLAT+152)
  LINE (PLAT+346,PLAT+89 ,PLAT+153)
  LINE (PLAT+347,PLAT+90 ,PLAT+154)
  LINE (PLAT+348,PLAT+153,PLAT+154)
  LINE (PLAT+349,PLAT+154,PLAT+155)
(*
  LINE (PLAT+350,PLAT+91 ,PLAT+155)
  LINE (PLAT+351,PLAT+152,PLAT+155)
  LINE (PLAT+352,PLAT+155,PLAT+156)
  LINE (PLAT+353,PLAT+92 ,PLAT+156)
  ARCCF(PLAT+354,PLAT+152,PLAT+157,937)
  LINE (PLAT+355,PLAT+151,PLAT+160)
  ARCCF(PLAT+356,PLAT+155,PLAT+158,909)
  LINE (PLAT+357,PLAT+93 ,PLAT+157)
  LINE (PLAT+358,PLAT+94 ,PLAT+158)
  LINE (PLAT+359,PLAT+157,PLAT+158)
(*
  LINE (PLAT+360,PLAT+157,PLAT+160)
  LINE (PLAT+361,PLAT+158,PLAT+159)
  LINE (PLAT+362,PLAT+95 ,PLAT+159)
  LINE (PLAT+363,PLAT+159,PLAT+160)
  LINE (PLAT+364,PLAT+96 ,PLAT+160)
(*
(* EXTRA CURVES THAT WERE FORGOTTEN BUT ARE NEEDED
(*
  LINE (PLAT+800,PLAT+102,PLAT+105)
  LINE (PLAT+801,PLAT+110,PLAT+111)
  LINE (PLAT+802,PLAT+106,PLAT+107)
  LINE (PLAT+803,PLAT+112,PLAT+113)
  LINE (PLAT+804,PLAT+139,PLAT+145)
  LINE (PLAT+805,PLAT+87 ,PLAT+151)
  LINE (PLAT+806,PLAT+140,PLAT+146)
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  LINE (PLAT+807,PLAT+141,PLAT+147)
  LINE (PLAT+808,PLAT+142,PLAT+148)
  LINE (PLAT+809,PLAT+143,PLAT+149)
  LINE (PLAT+810,PLAT+103,PLAT+104)
  LINE (PLAT+811,PLAT+105,PLAT+106)
  LINE (PLAT+812,PLAT+144,PLAT+150)
  LINE (PLAT+813,PLAT+156,PLAT+159)
  LINE (907,PLAT+127,PLAT+128)
(*
(* DELETE TEMPORARY POINTS THAT WERE CONSTRUCTED
(*
  DELETEPT (900)
  DELETEPT (901)
  DELETEPT (902)
  DELETEPT (903)
  DELETEPT (904)
  DELETEPT (905)
  DELETEPT (906)
  DELETEPT (907)
  DELETEPT (908)
  DELETEPT (909)
(*
  DELETEPT (910)
  DELETEPT (911)
  DELETEPT (912)
  DELETEPT (913)
  DELETEPT (914)
  DELETEPT (915)
  DELETEPT (916)
  DELETEPT (917)
  DELETEPT (918)
  DELETEPT (919)
(*
  DELETEPT (920)
  DELETEPT (921)
  DELETEPT (922)
  DELETEPT (923)
  DELETEPT (924)
  DELETEPT (925)
  DELETEPT (926)
  DELETEPT (927)
  DELETEPT (928)
  DELETEPT (929)
(*
  DELETEPT (930)
  DELETEPT (931)
  DELETEPT (932)
  DELETEPT (933)
  DELETEPT (934)
  DELETEPT (935)
  DELETEPT (936)
  DELETEPT (937)
(*
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(**************************************************************
(*                                                            *
(*            - PLATFORM SURFACE DEFINITIONS                  *
(*                DEFINE EMBOSS SURFACES                      *
(*                                                            *
(**************************************************************
(*
(* SURFACES FOR REGION 19
(*
  RULEDSRF (PLAT+90 ,PLAT+137,PLAT+200)
  RULEDSRF (PLAT+91 ,PLAT+137,PLAT+139)
  RULEDSRF (PLAT+92 ,PLAT+200,PLAT+203)
  RULEDSRF (PLAT+93 ,PLAT+138,PLAT+202)
  RULEDSRF (PLAT+94 ,PLAT+140,PLAT+206)
  RULEDSRF (PLAT+95 ,PLAT+139,PLAT+203)
(*
(* SURFACES FOR REGION 20
(*
  RULEDSRF (PLAT+96 ,PLAT+141,PLAT+208)
  RULEDSRF (PLAT+97 ,PLAT+150,PLAT+210)
  RULEDSRF (PLAT+98 ,PLAT+142,PLAT+212)
  RULEDSRF (PLAT+99 ,PLAT+141,PLAT+142)
  RULEDSRF (PLAT+100,PLAT+208,PLAT+212)
(*
(* SURFACES FOR REGION 21
(*
  RULEDSRF (PLAT+101,PLAT+151,PLAT+235)
  RULEDSRF (PLAT+102,PLAT+152,PLAT+227)
  RULEDSRF (PLAT+103,PLAT+88 ,PLAT+236)
  RULEDSRF (PLAT+104,PLAT+151,PLAT+88)
  RULEDSRF (PLAT+105,PLAT+235,PLAT+236)
(*
(* SURFACES FOR REGION 22
(*
  RULEDSRF (PLAT+106,PLAT+156,PLAT+241)
  RULEDSRF (PLAT+107,PLAT+157,PLAT+249)
  RULEDSRF (PLAT+108,PLAT+96 ,PLAT+242)
  RULEDSRF (PLAT+109,PLAT+156,PLAT+96)
  RULEDSRF (PLAT+110,PLAT+241,PLAT+242)
(*
(* SURFACES FOR REGION 23
(*
  RULEDSRF (PLAT+111,PLAT+160,PLAT+258)
  RULEDSRF (PLAT+112,PLAT+161,PLAT+265)
  RULEDSRF (PLAT+113,PLAT+104,PLAT+259)
  RULEDSRF (PLAT+114,PLAT+160,PLAT+104)
  RULEDSRF (PLAT+115,PLAT+258,PLAT+259)
(*
(* SURFACES FOR REGION 24
(*
  RULEDSRF (PLAT+116,PLAT+164,PLAT+275)
  RULEDSRF (PLAT+117,PLAT+165,PLAT+282)
  RULEDSRF (PLAT+118,PLAT+112,PLAT+276)
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 RULEDSRF (PLAT+119,PLAT+164,PLAT+112)
 RULEDSRF (PLAT+120,PLAT+275,PLAT+276)
(*
(* SURFACES FOR REGION 25
(*
 RULEDSRF (PLAT+121,PLAT+168,PLAT+292)
 RULEDSRF (PLAT+122,PLAT+169,PLAT+299)
 RULEDSRF (PLAT+123,PLAT+120,PLAT+293)
 RULEDSRF (PLAT+124,PLAT+165,PLAT+169)
 RULEDSRF (PLAT+125,PLAT+292,PLAT+293)
 RULEDSRF (906,PLAT+165,PLAT+907)
(*
(* SURFACES FOR REGION 26
(*
 RULEDSRF (PLAT+126,PLAT+172,PLAT+309)
 RULEDSRF (PLAT+127,PLAT+173,PLAT+316)
 RULEDSRF (PLAT+128,PLAT+128,PLAT+310)
 RULEDSRF (PLAT+129,PLAT+172,PLAT+128)
 RULEDSRF (PLAT+130,PLAT+309,PLAT+310)
(*
(* SURFACES FOR REGION 27
(*
 RULEDSRF (PLAT+131,PLAT+177,PLAT+327)
 RULEDSRF (PLAT+132,PLAT+136,PLAT+806)
 RULEDSRF (PLAT+133,PLAT+176,PLAT+136)
 RULEDSRF (PLAT+134,PLAT+804,PLAT+806)
 RULEDSRF (PLAT+330,PLAT+176,PLAT+804)
(*
(* SURFACES FOR REGION 28
(*
 RULEDSRF (PLAT+135,PLAT+180,PLAT+337)
 RULEDSRF (PLAT+136,PLAT+181,PLAT+343)
 RULEDSRF (PLAT+137,PLAT+182,PLAT+338)
 RULEDSRF (PLAT+138,PLAT+180,PLAT+182)
 RULEDSRF (PLAT+139,PLAT+337,PLAT+338)
(*
(* SURFACES FOR REGION 29
(*
 RULEDSRF (PLAT+300,PLAT+8  ,PLAT+800)
 RULEDSRF (PLAT+301,PLAT+143,PLAT+214)
 RULEDSRF (PLAT+302,PLAT+144,PLAT+215)
 RULEDSRF (PLAT+303,PLAT+142,PLAT+143)
 RULEDSRF (PLAT+304,PLAT+212,PLAT+214)
(*
(* SURFACES FOR REGION 30
(*
 RULEDSRF (PLAT+305,PLAT+88 ,PLAT+236)
 RULEDSRF (PLAT+306,PLAT+18 ,PLAT+801)
 RULEDSRF (PLAT+307,PLAT+86 ,PLAT+237)
 RULEDSRF (PLAT+308,PLAT+88 ,PLAT+86)
 RULEDSRF (PLAT+309,PLAT+236,PLAT+237)
(*
(* SURFACES FOR REGION 31
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(*
  RULEDSRF (PLAT+310.PLAT+96 .PLAT+242)
  RULEDSRF (PLAT+311.PLAT+28 .PLAT+250)
  RULEDSRF (PLAT+312.PLAT+94 .PLAT+243)
  RULEDSRF (PLAT+313.PLAT+96 .PLAT+94)
  RULEDSRF (PLAT+314.PLAT+242.PLAT+243)
(*
(* SURFACES FOR REGION 32
(*
  RULEDSRF (PLAT+315.PLAT+104.PLAT+259)
  RULEDSRF (PLAT+316.PLAT+38 .PLAT+267)
  RULEDSRF (PLAT+317.PLAT+102,PLAT+260)
  RULEDSRF (PLAT+318.PLAT+104.PLAT+102)
  RULEDSRF (PLAT+319.PLAT+259,PLAT+260)
(*
(* SURFACES FOR REGION 33
(*
  RULEDSRF (PLAT+320.PLAT+112.PLAT+276)
  RULEDSRF (PLAT+321.PLAT+48 ,PLAT+284)
  RULEDSRF (PLAT+322.PLAT+110.PLAT+277)
  RULEDSRF (PLAT+323.PLAT+112.PLAT+110)
  RULEDSRF (PLAT+324.PLAT+276.PLAT+277)
(*
(* SURFACES FOR REGION 34
(*
  RULEDSRF (PLAT+325.PLAT+120.PLAT+293)
  RULEDSRF (PLAT+326.PLAT+58 ,PLAT+301)
  RULEDSRF (PLAT+327.PLAT+118.PLAT+294)
  RULEDSRF (PLAT+328.PLAT+120.PLAT+118)
  RULEDSRF (PLAT+329.PLAT+293.PLAT+294)
(*
(* SURFACES FOR REGION 35
(*
  RULEDSRF (PLAT+146.PLAT+128.PLAT+310)
  RULEDSRF (PLAT+147.PLAT+68 .PLAT+318)
  RULEDSRF (PLAT+148.PLAT+126.PLAT+311)
  RULEDSRF (PLAT+149.PLAT+128.PLAT+126)
  RULEDSRF (PLAT+150.PLAT+310.PLAT+311)
(*
(* SURFACES FOR REGION 36
(*
  RULEDSRF (PLAT+151.PLAT+136.PLAT+806)
  RULEDSRF (PLAT+152.PLAT+78 .PLAT+329)
  RULEDSRF (PLAT+153.PLAT+134.PLAT+807)
  RULEDSRF (PLAT+154.PLAT+136,PLAT+134)
  RULEDSRF (PLAT+155,PLAT+806.PLAT+807)
(*
(* SURFACES FOR REGION 37
(*
  RULEDSRF (PLAT+156.PLAT+182.PLAT+338)
  RULEDSRF (PLAT+157.PLAT+183.PLAT+345)
  RULEDSRF (PLAT+158.PLAT+184.PLAT+339)
  RULEDSRF (PLAT+159.PLAT+182.PLAT+184)
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  RULEDSRF (PLAT+160.PLAT+338.PLAT+339)
(*
(* SURFACES FOR REGION 38
(*
  RULEDSRF (PLAT+161.PLAT+144.PLAT+215)
  RULEDSRF (PLAT+162.PLAT+145.PLAT+810)
  RULEDSRF (PLAT+163.PLAT+147.PLAT+218)
  RULEDSRF (PLAT+164.PLAT+145.PLAT+139)
  RULEDSRF (PLAT+165.PLAT+810.PLAT+203)
(*
(* SURFACES FOR REGION 39
(*
  RULEDSRF (PLAT+166.PLAT+143.PLAT+214)
  RULEDSRF (PLAT+167.PLAT+7  .PLAT+811)
  RULEDSRF (PLAT+168.PLAT+146.PLAT+219)
  RULEDSRF (PLAT+169.PLAT+143.PLAT+146)
  RULEDSRF (PLAT+170.PLAT+214.PLAT+219)
(*
(* SURFACES FOR REGION 40
(*
  RULEDSRF (PLAT+171.PLAT+86 .PLAT+237)
  RULEDSRF (PLAT+172.PLAT+17 .PLAT+230)
  RULEDSRF (PLAT+173.PLAT+84 .PLAT+238)
  RULEDSRF (PLAT+174.PLAT+86 .PLAT+84)
  RULEDSRF (PLAT+175.PLAT+237.PLAT+238)
(*
(* SURFACES FOR REGION 41
(*
  RULEDSRF (PLAT+176.PLAT+27 .PLAT+252)
  RULEDSRF (PLAT+177.PLAT+37 .PLAT+269)
  RULEDSRF (PLAT+178.PLAT+100.PLAT+261)
  RULEDSRF (PLAT+179.PLAT+102.PLAT+100)
  RULEDSRF (PLAT+180.PLAT+260.PLAT+261)
(*
(* SURFACES FOR REGION 42
(*
  RULEDSRF (PLAT+181.PLAT+47 .PLAT+286)
  RULEDSRF (PLAT+182.PLAT+57 .PLAT+303)
  RULEDSRF (PLAT+183.PLAT+116.PLAT+295)
  RULEDSRF (PLAT+184.PLAT+118.PLAT+116)
  RULEDSRF (PLAT+185.PLAT+294.PLAT+295)
(*
(* SURFACES FOR REGION 43
(*
  RULEDSRF (PLAT+186.PLAT+67 .PLAT+320)
  RULEDSRF (PLAT+187.PLAT+77 .PLAT+331)
  RULEDSRF (PLAT+188.PLAT+132.PLAT+808)
  RULEDSRF (PLAT+189.PLAT+134.PLAT+132)
  RULEDSRF (PLAT+190.PLAT+807.PLAT+808)
(*
(* SURFACES FOR REGION 44
(*
  RULEDSRF (PLAT+191.PLAT+184.PLAT+339)
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  RULEDSRF (PLAT+192,PLAT+185,PLAT+348)
  RULEDSRF (PLAT+193,PLAT+186,PLAT+340)
  RULEDSRF (PLAT+194,PLAT+184,PLAT+186)
  RULEDSRF (PLAT+195,PLAT+339,PLAT+340)
(*
(* SURFACES FOR REGION 45
(*
  RULEDSRF (PLAT+196,PLAT+183,PLAT+345)
  RULEDSRF (PLAT+197,PLAT+191,PLAT+351)
  RULEDSRF (PLAT+198,PLAT+187,PLAT+349)
  RULEDSRF (PLAT+199,PLAT+183,PLAT+187)
  RULEDSRF (PLAT+200,PLAT+345,PLAT+349)
(*
(* SURFACES FOR REGION 46
(*
  RULEDSRF (PLAT+201,PLAT+6  ,PLAT+802)
  RULEDSRF (PLAT+202,PLAT+148,PLAT+221)
  RULEDSRF (PLAT+203,PLAT+146,PLAT+148)
  RULEDSRF (PLAT+204,PLAT+219,PLAT+221)
(*
(* SURFACES FOR REGION 47
(*
  RULEDSRF (PLAT+205,PLAT+16 ,PLAT+803)
  RULEDSRF (PLAT+206,PLAT+82 ,PLAT+239)
  RULEDSRF (PLAT+207,PLAT+84 ,PLAT+82)
  RULEDSRF (PLAT+208,PLAT+238,PLAT+239)
(*
(* SURFACES FOR REGION 48
(*
  RULEDSRF (PLAT+209,PLAT+92 ,PLAT+244)
  RULEDSRF (PLAT+210,PLAT+26 ,PLAT+254)
  RULEDSRF (PLAT+211,PLAT+90 ,PLAT+245)
  RULEDSRF (PLAT+212,PLAT+92 ,PLAT+90)
  RULEDSRF (PLAT+213,PLAT+244,PLAT+245)
(*
(* SURFACES FOR REGION 49
(*
  RULEDSRF (PLAT+214,PLAT+100,PLAT+261)
  RULEDSRF (PLAT+215,PLAT+36 ,PLAT+271)
  RULEDSRF (PLAT+216,PLAT+98 ,PLAT+262)
  RULEDSRF (PLAT+217,PLAT+100,PLAT+98)
  RULEDSRF (PLAT+218,PLAT+261,PLAT+262)
(*
(* SURFACES FOR REGION 50
(*
  RULEDSRF (PLAT+219,PLAT+108,PLAT+278)
  RULEDSRF (PLAT+220,PLAT+46 ,PLAT+288)
  RULEDSRF (PLAT+221,PLAT+106,PLAT+279)
  RULEDSRF (PLAT+222,PLAT+108,PLAT+106)
  RULEDSRF (PLAT+223,PLAT+278,PLAT+279)
(*
(* SURFACES FOR REGION 51
(*
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 RULEDSRF (PLAT+224,PLAT+116,PLAT+295)
 RULEDSRF (PLAT+225,PLAT+56 ,PLAT+305)
 RULEDSRF (PLAT+226,PLAT+114,PLAT+296)
 RULEDSRF (PLAT+227,PLAT+116,PLAT+114)
 RULEDSRF (PLAT+228,PLAT+295,PLAT+296)
(*
(* SURFACES FOR REGION 52
(*
 RULEDSRF (PLAT+229,PLAT+124,PLAT+312)
 RULEDSRF (PLAT+230,PLAT+66 ,PLAT+322)
 RULEDSRF (PLAT+231,PLAT+122,PLAT+313)
 RULEDSRF (PLAT+232,PLAT+124,PLAT+122)
 RULEDSRF (PLAT+233,PLAT+312,PLAT+313)
(*
(* SURFACES FOR REGION 53
(*
 RULEDSRF (PLAT+234,PLAT+132,PLAT+808)
 RULEDSRF (PLAT+235,PLAT+76 ,PLAT+333)
 RULEDSRF (PLAT+236,PLAT+130,PLAT+809)
 RULEDSRF (PLAT+237,PLAT+132,PLAT+130)
 RULEDSRF (PLAT+238,PLAT+808,PLAT+809)
(*
(* SURFACES FOR REGION 54
(*
 RULEDSRF (PLAT+239,PLAT+186,PLAT+340)
 RULEDSRF (PLAT+240,PLAT+187,PLAT+349)
 RULEDSRF (PLAT+241,PLAT+188,PLAT+341)
 RULEDSRF (PLAT+242,PLAT+186,PLAT+188)
 RULEDSRF (PLAT+243,PLAT+340,PLAT+341)
(*
(* SURFACES FOR REGION 55
(*
 RULEDSRF (PLAT+244,PLAT+192,PLAT+354)
 RULEDSRF (PLAT+245,PLAT+199,PLAT+359)
 RULEDSRF (PLAT+246,PLAT+194,PLAT+356)
 RULEDSRF (PLAT+247,PLAT+192,PLAT+194)
 RULEDSRF (PLAT+248,PLAT+354,PLAT+356)
(*
(* SURFACES FOR REGION 56
(*
 RULEDSRF (PLAT+249,PLAT+153,PLAT+224)
 RULEDSRF (PLAT+250,PLAT+149,PLAT+222)
 RULEDSRF (PLAT+251,PLAT+148,PLAT+149)
 RULEDSRF (PLAT+252,PLAT+221,PLAT+222)
(*
(* SURFACES FOR REGION 57
(*
 RULEDSRF (PLAT+253,PLAT+154,PLAT+233)
 RULEDSRF (PLAT+254,PLAT+155,PLAT+240)
 RULEDSRF (PLAT+255,PLAT+82 ,PLAT+155)
 RULEDSRF (PLAT+256,PLAT+239,PLAT+240)
(*
(* SURFACES FOR REGION 58
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(*
  RULEDSRF (PLAT+257,PLAT+158,PLAT+256)
  RULEDSRF (PLAT+258,PLAT+159 PLAT+246)
  RULEDSRF (PLAT+259,PLAT+90  ,PLAT+159)
  RULEDSRF (PLAT+260,PLAT+245,PLAT+246)
(*
(* SURFACES FOR REGION 59
(*
  RULEDSRF (PLAT+261,PLAT+162,PLAT+273)
  RULEDSRF (PLAT+262,PLAT+163,PLAT+263)
  RULEDSRF (PLAT+263,PLAT+98  ,PLAT+163)
  RULEDSRF (PLAT+264,PLAT+262,PLAT+263)
(*
(* SURFACES FOR REGION 60
(*
  RULEDSRF (PLAT+265,PLAT+166,PLAT+290)
  RULEDSRF (PLAT+266,PLAT+167,PLAT+280)
  RULEDSRF (PLAT+267,PLAT+106,PLAT+167)
  RULEDSRF (PLAT+268,PLAT+279,PLAT+280)
(*
(* SURFACES FOR REGION 61
(*
  RULEDSRF (PLAT+269,PLAT+170,PLAT+307)
  RULEDSRF (PLAT+270,PLAT+171,PLAT+297)
  RULEDSRF (PLAT+271,PLAT+114,PLAT+171)
  RULEDSRF (PLAT+272,PLAT+296,PLAT+297)
(*
(* SURFACES FOR REGION 62
(*
  RULEDSRF (PLAT+273,PLAT+174,PLAT+324)
  RULEDSRF (PLAT+274,PLAT+175,PLAT+314)
  RULEDSRF (PLAT+275,PLAT+122,PLAT+175)
  RULEDSRF (PLAT+276,PLAT+313,PLAT+314)
(*
(* SURFACES FOR REGION 63
(*
  RULEDSRF (PLAT+277,PLAT+178,PLAT+335)
  RULEDSRF (PLAT+278,PLAT+179,PLAT+812)
  RULEDSRF (PLAT+279,PLAT+130,PLAT+179)
  RULEDSRF (PLAT+[illegible] PLAT+809,PLAT+812)
(*
(* SURFACES FOR REGION 64
(*
  RULEDSRF (PLAT+281,PLAT+189,PLAT+352)
  RULEDSRF (PLAT+282,PLAT+190,PLAT+342)
  RULEDSRF (PLAT+283,PLAT+188,PLAT+190)
  RULEDSRF (PLAT+284,PLAT+341,PLAT+342)
(*
(* SURFACES FOR REGION 65
(*
  RULEDSRF (PLAT+285,PLAT+195,PLAT+361)
  RULEDSRF (PLAT+286,PLAT+196,PLAT+813)
  RULEDSRF (PLAT+287,PLAT+194,PLAT+196)
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RULEDSRF (PLAT+288.PLAT+356.PLAT+813)
(*
(* SURFACES FOR REGION 66
(*
 RULEDSRF (PLAT+289.PLAT+197.PLAT+360)
 RULEDSRF (PLAT+290.PLAT+198.PLAT+363)
 RULEDSRF (PLAT+291.PLAT+195.PLAT+197)
 RULEDSRF (PLAT+292.PLAT+361.PLAT+360)
(*
(* SURFACES FOR REGION 67
(*
 RULEDSRF (PLAT+293.PLAT+193,PLAT+355)
 RULEDSRF (PLAT+294.PLAT+192,PLAT+193)
 RULEDSRF (PLAT+295.PLAT+354,PLAT+355)
(*
(**************************************************************
(*                                                            *
(*                - PLATFORM REGION DEFINITIONS -             *
(*                     DEFINE ESMOSS REGIONS                  *
(*                                                            *
(**************************************************************
(*
(*              DEFINE REGION 19
(*
 REG3D (19.PLAT+90 .PLAT+91 ,PLAT+92 .PLAT+93 .PLAT+94 .PLAT+95 . &
        PLAT+137.PLAT+138.PLAT+139.PLAT+140.PLAT+200.PLAT+202. &
        PLAT+203.PLAT+206.PLAT+201.PLAT+204.PLAT+205.PLAT+207. &
        PLAT+65 .PLAT+66 ,PLAT+67 ,PLAT+97 .PLAT+98 ,PLAT+99 . &
        PLAT+100.PLAT+68)
(*
(*              DEFINE REGION 20
(*
 REG3D (20.PLAT+93 .PLAT+96 ,PLAT+97 ,PLAT+98 .PLAT+99 ,PLAT+100. &
        PLAT+138.PLAT+141.PLAT+142.PLAT+150.PLAT+201,PLAT+202. &
        PLAT+204.PLAT+208.PLAT+212,PLAT+209.PLAT+210,PLAT+211. &
        PLAT+65 .PLAT+66 .PLAT+71 ,PLAT+4   ,PLAT+97 ,PLAT+98 . &
        PLAT+101.PLAT+102)
(*
(*              DEFINE REGION 21
(*
 REG3D (21.PLAT+97  PLAT+101,PLAT+102,PLAT+103.PLAT+104,PLAT+105. &
        PLAT+150.PLAT+151.PLAT+152,PLAT+88 .PLAT+235.PLAT+210. &
        PLAT+227 PLAT+236.PLAT+209,PLAT+226.PLAT+211.PLAT+228, &
        PLAT+71 .PLAT+73 ,PLAT+4   ,PLAT+101.PLAT+102.PLAT+109. &
        PLAT+110.PLAT+8)
(*
(*              DEFINE REGION 22
(*
 REG3D (22,PLAT+102,PLAT+106,PLAT+107,PLAT+108.PLAT+109,PLAT+110, &
        PLAT+152,PLAT+156,PLAT+157,PLAT+96  .PLAT+227,PLAT+241. &
        PLAT+249,PLAT+242,PLAT+226,PLAT+247,PLAT+228,PLAT+248. &
        PLAT+73 ,PLAT+75 ,PLAT+8   .PLAT+12 .PLAT+109,PLAT+110, &
        PLAT+115,PLAT+116)
```

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(*
(*              DEFINE REGION 23
(*
 REG3D (23,PLAT+107,PLAT+111,PLAT+112,PLAT+113,PLAT+114,PLAT+115, &
        PLAT+157,PLAT+160,PLAT+161,PLAT+104,PLAT+258,PLAT+265, &
        PLAT+259,PLAT+249,PLAT+247,PLAT+264,PLAT+266,PLAT+248, &
        PLAT+75 ,PLAT+77 ,PLAT+12 ,PLAT+16 ,PLAT+115,PLAT+121, &
        PLAT+116,PLAT+122)
(*
(*              DEFINE REGION 24
(*
 REG3D (24,PLAT+112,PLAT+116,PLAT+117,PLAT+118,PLAT+119,PLAT+120, &
        PLAT+161,PLAT+164,PLAT+165,PLAT+112,PLAT+265,PLAT+275, &
        PLAT+282,PLAT+276,PLAT+264,PLAT+281,PLAT+283,PLAT+266, &
        PLAT+77 ,PLAT+79 ,PLAT+16 ,PLAT+20 ,PLAT+121,PLAT+127, &
        PLAT+122,PLAT+128)
(*
(*              DEFINE REGION 25
(*
 REG3D (25,PLAT+124,PLAT+125,PLAT+121,PLAT+122,PLAT+123,PLAT+117, &
        PLAT+168,PLAT+169,PLAT+120,PLAT+165,PLAT+292,PLAT+299, &
        PLAT+282,PLAT+293,PLAT+281,PLAT+298,PLAT+283,PLAT+300, &
        PLAT+79 ,PLAT+20 ,PLAT+24 ,PLAT+81 ,PLAT+127,PLAT+128, &
        PLAT+133,PLAT+134)
(*
(*              DEFINE REGION 26
(*
 REG3D (26,PLAT+122,PLAT+126,PLAT+127,PLAT+128,PLAT+129,PLAT+130, &
        PLAT+172,PLAT+173,PLAT+128,PLAT+169,PLAT+309,PLAT+316, &
        PLAT+310,PLAT+299,PLAT+298,PLAT+315,PLAT+317,PLAT+300, &
        PLAT+81 ,PLAT+83 ,PLAT+24 ,PLAT+28 ,PLAT+133,PLAT+139, &
        PLAT+134,PLAT+140)
(*
(*              DEFINE REGION 27
(*
 REG3D (27,PLAT+127,PLAT+330,PLAT+131,PLAT+132,PLAT+133,PLAT+134, &
        PLAT+173,PLAT+176,PLAT+177,PLAT+136,PLAT+316,PLAT+804, &
        PLAT+327,PLAT+806,PLAT+315,PLAT+326,PLAT+317,PLAT+328, &
        PLAT+83 ,PLAT+85 ,PLAT+28 ,PLAT+32 ,PLAT+139,PLAT+145, &
        PLAT+140,PLAT+146)
(*
(*              DEFINE REGION 28
(*
 REG3D (28,PLAT+131,PLAT+135,PLAT+136,PLAT+137,PLAT+138,PLAT+139, &
        PLAT+180,PLAT+181,PLAT+182,PLAT+177,PLAT+337,PLAT+343, &
        PLAT+338,PLAT+327,PLAT+326,PLAT+805,PLAT+344,PLAT+328, &
        PLAT+85 ,PLAT+87 ,PLAT+88 ,PLAT+32 ,PLAT+145,PLAT+151, &
        PLAT+146,PLAT+152)
(*
(*              DEFINE REGION 29
(*
 REG3D (29,PLAT+98 ,PLAT+300,PLAT+301,PLAT+302,PLAT+303,PLAT+304, &
        PLAT+142,PLAT+8  ,PLAT+143,PLAT+144,PLAT+212,PLAT+800, &
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 PLAT+214,PLAT+215,PLAT+204,PLAT+211,PLAT+213,PLAT+216, &
 PLAT+66 ,PLAT+4  ,PLAT+34 ,PLAT+69 ,PLAT+98 ,PLAT+102, &
 PLAT+103,PLAT+105)
(*
(*          DEFINE REGION 30
(*
 REG3D (30,PLAT+300,PLAT+305,PLAT+306,PLAT+307,PLAT+308,PLAT+309, &
       PLAT+8  ,PLAT+88 ,PLAT+18 ,PLAT+86 ,PLAT+236,PLAT+801, &
       PLAT+237,PLAT+800,PLAT+211,PLAT+228,PLAT+229,PLAT+213, &
       PLAT+4  ,PLAT+8  ,PLAT+34 ,PLAT+38 ,PLAT+102,PLAT+110, &
       PLAT+105,PLAT+111)
(*
(*          DEFINE REGION 31
(*
 REG3D (31,PLAT+306,PLAT+310,PLAT+311,PLAT+312,PLAT+313,PLAT+314, &
       PLAT+18 ,PLAT+96 ,PLAT+28 ,PLAT+94 ,PLAT+242,PLAT+250, &
       PLAT+243,PLAT+801,PLAT+228,PLAT+248,PLAT+251,PLAT+229, &
       PLAT+8  ,PLAT+12 ,PLAT+38 ,PLAT+42 ,PLAT+110,PLAT+111, &
       PLAT+116,PLAT+117)
(*
(*          DEFINE REGION 32
(*
 REG3D (32,PLAT+311,PLAT+315,PLAT+316,PLAT+317,PLAT+318,PLAT+319, &
       PLAT+28 ,PLAT+104,PLAT+38 ,PLAT+102,PLAT+259,PLAT+267, &
       PLAT+260,PLAT+250,PLAT+248,PLAT+266,PLAT+268,PLAT+251, &
       PLAT+12 ,PLAT+16 ,PLAT+42 ,PLAT+46 ,PLAT+116,PLAT+117, &
       PLAT+122,PLAT+123)
(*
(*          DEFINE REGION 33
(*
 REG3D (33,PLAT+316,PLAT+320,PLAT+321,PLAT+322,PLAT+323,PLAT+324, &
       PLAT+38 ,PLAT+112,PLAT+48 ,PLAT+110,PLAT+267,PLAT+276, &
       PLAT+284,PLAT+277,PLAT+266,PLAT+283,PLAT+285,PLAT+268, &
       PLAT+16 ,PLAT+20 ,PLAT+46 ,PLAT+50 ,PLAT+122,PLAT+123, &
       PLAT+128,PLAT+129)
(*
(*          DEFINE REGION 34
(*
 REG3D (34,PLAT+321,PLAT+325,PLAT+326,PLAT+327,PLAT+328,PLAT+329, &
       PLAT+48 ,PLAT+120,PLAT+58 ,PLAT+118,PLAT+284,PLAT+293, &
       PLAT+301,PLAT+294,PLAT+283,PLAT+300,PLAT+302,PLAT+285, &
       PLAT+20 ,PLAT+24 ,PLAT+50 ,PLAT+54 ,PLAT+128,PLAT+129, &
       PLAT+134,PLAT+135)
(*
(*          DEFINE REGION 35
(*
 REG3D (35,PLAT+326,PLAT+146,PLAT+147,PLAT+148,PLAT+149,PLAT+150, &
       PLAT+58 ,PLAT+128,PLAT+68 ,PLAT+126,PLAT+301,PLAT+310, &
       PLAT+318,PLAT+311,PLAT+300,PLAT+317,PLAT+319,PLAT+302, &
       PLAT+24 ,PLAT+28 ,PLAT+54 ,PLAT+58 ,PLAT+134,PLAT+135, &
       PLAT+140,PLAT+141)
(*
(*          DEFINE REGION 36
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(*
 REG3D (36.PLAT+147.PLAT+151.PLAT+152.PLAT+153.PLAT+154.PLAT+155, &
        PLAT+68 .PLAT+136.PLAT+78 .PLAT+134.PLAT+806.PLAT+329, &
        PLAT+807.PLAT+318.PLAT+317.PLAT+328.PLAT+330.PLAT+319, &
        PLAT+28 .PLAT+32 .PLAT+58 .PLAT+62 .PLAT+140.PLAT+141, &
        PLAT+146.PLAT+147)
(*
(*           DEFINE REGION 37
(*
 REG3D (37.PLAT+152.PLAT+156.PLAT+157,PLAT+158.PLAT+159,PLAT+160, &
        PLAT+78 .PLAT+182.PLAT+183,PLAT+184,PLAT+338.PLAT+345, &
        PLAT+339.PLAT+329,PLAT+328.PLAT+344,PLAT+346,PLAT+330, &
        PLAT+146.PLAT+152.PLAT+153,PLAT+147,PLAT+32 ,PLAT+62 , &
        PLAT+88 .PLAT+89)
(*
(*           DEFINE REGION 38
(*
 REG3D (38.PLAT+95 .PLAT+161.PLAT+162,PLAT+163,PLAT+164.PLAT+165, &
        PLAT+144.PLAT+145,PLAT+147,PLAT+139,PLAT+203,PLAT+215, &
        PLAT+810.PLAT+218.PLAT+204.PLAT+216,PLAT+217,PLAT+205, &
        PLAT+66 ,PLAT+69 ,PLAT+67 ,PLAT+70 ,PLAT+98 ,PLAT+99 , &
        PLAT+103.PLAT+104)
(*
(*           DEFINE REGION 39
(*
 REG3D (39,PLAT+162,PLAT+166,PLAT+167.PLAT+168,PLAT+169.PLAT+170, &
        PLAT+145,PLAT+143,PLAT+7   ,PLAT+146.PLAT+810,PLAT+214, &
        PLAT+811.PLAT+219,PLAT+216,PLAT+217.PLAT+213.PLAT+220, &
        PLAT+69 .PLAT+70 ,PLAT+34 ,PLAT+36 ,PLAT+103,PLAT+104, &
        PLAT+105.PLAT+106)
(*
(*           DEFINE REGION 40
(*
 REG3D (40.PLAT+167.PLAT+171.PLAT+172,PLAT+173,PLAT+174.PLAT+175, &
        PLAT+7   .PLAT+86 .PLAT+17 ,PLAT+84 ,PLAT+237.PLAT+230, &
        PLAT+238.PLAT+811.PLAT+213,PLAT+229,PLAT+231,PLAT+220, &
        PLAT+34 .PLAT+36 .PLAT+38 ,PLAT+40 ,PLAT+105,PLAT+106, &
        PLAT+111.PLAT+112)
(*
(*           DEFINE REGION 41
(*
 REG3D (41.PLAT+317.PLAT+176,PLAT+177,PLAT+178,PLAT+179.PLAT+180, &
        PLAT+27 ,PLAT+102.PLAT+37 ,PLAT+100,PLAT+252.PLAT+260, &
        PLAT+269.PLAT+261,PLAT+251,PLAT+268.PLAT+253.PLAT+270, &
        PLAT+42 ,PLAT+44 .PLAT+46 ,PLAT+48 ,PLAT+117,PLAT+118, &
        PLAT+123.PLAT+124)
(*
(*           DEFINE REGION 42
(*
 REG3D (42.PLAT+327.PLAT+181.PLAT+182,PLAT+183,PLAT+184,PLAT+185, &
        PLAT+47 ,PLAT+118,PLAT+57 ,PLAT+116,PLAT+294,PLAT+303, &
        PLAT+295,PLAT+286,PLAT+285,PLAT+302,PLAT+304,PLAT+287, &
        PLAT+50 ,PLAT+52 ,PLAT+54 ,PLAT+56 ,PLAT+129.PLAT+130, &
```

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        PLAT+135,PLAT+136)
(*
(*              DEFINE REGION 43
(*
  REG3D (43,PLAT+153,PLAT+186,PLAT+187,PLAT+188,PLAT+189,PLAT+190, &
        PLAT+67 ,PLAT+134,PLAT+77 ,PLAT+132,PLAT+807,PLAT+331, &
        PLAT+808,PLAT+320,PLAT+319,PLAT+330,PLAT+332,PLAT+321, &
        PLAT+58 ,PLAT+60 ,PLAT+62 ,PLAT+64 ,PLAT+141,PLAT+142, &
        PLAT+147,PLAT+148)
(*
(*              DEFINE REGION 44
(*
  REG3D (44,PLAT+187,PLAT+191,PLAT+192,PLAT+193,PLAT+194,PLAT+195, &
        PLAT+77 ,PLAT+184,PLAT+185,PLAT+186,PLAT+347,PLAT+331, &
        PLAT+339,PLAT+348,PLAT+340,PLAT+330,PLAT+332,PLAT+346, &
        PLAT+62 ,PLAT+64 ,PLAT+89 ,PLAT+90 ,PLAT+147,PLAT+148, &
        PLAT+153,PLAT+154)
(*
(*              DEFINE REGION 45
(*
  REG3D (45,PLAT+192,PLAT+196,PLAT+197,PLAT+198,PLAT+199,PLAT+200, &
        PLAT+185,PLAT+183,PLAT+191,PLAT+187,PLAT+345,PLAT+351, &
        PLAT+349,PLAT+348,PLAT+347,PLAT+346,PLAT+344,PLAT+350, &
        PLAT+89 ,PLAT+90 ,PLAT+88 ,PLAT+91 ,PLAT+153,PLAT+154, &
        PLAT+152,PLAT+155)
(*
(*              DEFINE REGION 46
(*
  REG3D (46,PLAT+163,PLAT+201,PLAT+202,PLAT+203,PLAT+204,PLAT+168, &
        PLAT+147,PLAT+146,PLAT+6  ,PLAT+148,PLAT+218,PLAT+219, &
        PLAT+802,PLAT+221,PLAT+217,PLAT+220,PLAT+223,PLAT+205, &
        PLAT+67 ,PLAT+70 ,PLAT+36 ,PLAT+2  ,PLAT+99 ,PLAT+104, &
        PLAT+106,PLAT+107)
(*
(*              DEFINE REGION 47
(*
  REG3D (47,PLAT+201,PLAT+173,PLAT+205,PLAT+206,PLAT+207,PLAT+208, &
        PLAT+6  ,PLAT+84 ,PLAT+16 ,PLAT+82 ,PLAT+238,PLAT+803, &
        PLAT+802,PLAT+239,PLAT+220,PLAT+231,PLAT+232,PLAT+223, &
        PLAT+36 ,PLAT+2  ,PLAT+40 ,PLAT+6  ,PLAT+106,PLAT+107, &
        PLAT+112,PLAT+113)
(*
(*              DEFINE REGION 48
(*
  REG3D (48,PLAT+205,PLAT+209,PLAT+210,PLAT+211,PLAT+212,PLAT+213, &
        PLAT+16 ,PLAT+92 ,PLAT+26 ,PLAT+90 ,PLAT+244,PLAT+254, &
        PLAT+245,PLAT+803,PLAT+231,PLAT+253,PLAT+255,PLAT+232, &
        PLAT+40 ,PLAT+6  ,PLAT+44 ,PLAT+10 ,PLAT+112,PLAT+113, &
        PLAT+118,PLAT+119)
(*
(*              DEFINE REGION 49
(*
  REG3D (49,PLAT+214,PLAT+215,PLAT+216,PLAT+217,PLAT+218,PLAT+210, &
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-       PLAT+26  ,PLAT+100,PLAT+36  ,PLAT+98  ,PLAT+261,PLAT+271, &
        PLAT+262,PLAT+254,PLAT+253,PLAT+270,PLAT+272,PLAT+255, &
        PLAT+44  ,PLAT+10  ,PLAT+48  ,PLAT+14  ,PLAT+118,PLAT+119, &
        PLAT+124,PLAT+125)
(*
(*           DEFINE REGION 50
(*
  REG3D (50,PLAT+215,PLAT+219,PLAT+220,PLAT+221,PLAT+222,PLAT+223, &
        PLAT+36  ,PLAT+108,PLAT+46  ,PLAT+106,PLAT+278,PLAT+288, &
        PLAT+279,PLAT+271,PLAT+270,PLAT+287,PLAT+289,PLAT+272, &
        PLAT+48  ,PLAT+14  ,PLAT+52  ,PLAT+18  ,PLAT+124,PLAT+125, &
        PLAT+130,PLAT+131)
(*
(*           DEFINE REGION 51
(*
  REG3D (51,PLAT+220,PLAT+224,PLAT+225,PLAT+226,PLAT+227,PLAT+228, &
        PLAT+46  ,PLAT+116,PLAT+56  ,PLAT+114,PLAT+295,PLAT+305, &
        PLAT+296,PLAT+288,PLAT+289,PLAT+287,PLAT+304,PLAT+306, &
        PLAT+52  ,PLAT+18  ,PLAT+56  ,PLAT+22  ,PLAT+130,PLAT+131, &
        PLAT+136,PLAT+137)
(*
(*           DEFINE REGION 52
(*
  REG3D (52,PLAT+225,PLAT+229,PLAT+230,PLAT+231,PLAT+232,PLAT+233, &
        PLAT+56  ,PLAT+124,PLAT+66  ,PLAT+122,PLAT+312,PLAT+322, &
        PLAT+313,PLAT+305,PLAT+304,PLAT+321,PLAT+323,PLAT+306, &
        PLAT+56  ,PLAT+22  ,PLAT+60  ,PLAT+26  ,PLAT+136,PLAT+137, &
        PLAT+142,PLAT+143)
(*
(*           DEFINE REGION 53
(*
  REG3D (53,PLAT+230,PLAT+234,PLAT+235,PLAT+236,PLAT+237,PLAT+238, &
        PLAT+66  ,PLAT+132,PLAT+76  ,PLAT+130,PLAT+808,PLAT+333, &
        PLAT+809,PLAT+322,PLAT+321,PLAT+332,PLAT+334,PLAT+323, &
        PLAT+60  ,PLAT+26  ,PLAT+64  ,PLAT+30  ,PLAT+142,PLAT+143, &
        PLAT+148,PLAT+149)
(*
(*           DEFINE REGION 54
(*
  REG3D (54,PLAT+235,PLAT+239,PLAT+240,PLAT+241,PLAT+242,PLAT+243, &
        PLAT+76  ,PLAT+186,PLAT+187,PLAT+188,PLAT+333,PLAT+340, &
        PLAT+349,PLAT+341,PLAT+332,PLAT+347,PLAT+350,PLAT+334, &
        PLAT+64  ,PLAT+30  ,PLAT+90  ,PLAT+91  ,PLAT+148,PLAT+149, &
        PLAT+154,PLAT+155)
(*
(*           DEFINE REGION 55
(*
  REG3D (55,PLAT+197,PLAT+244,PLAT+245,PLAT+246,PLAT+247,PLAT+248, &
        PLAT+191,PLAT+192,PLAT+194,PLAT+199,PLAT+351,PLAT+354, &
        PLAT+356,PLAT+359,PLAT+344,PLAT+357,PLAT+358,PLAT+350, &
        PLAT+88  ,PLAT+91  ,PLAT+93  ,PLAT+94  ,PLAT+152,PLAT+155, &
        PLAT+157,PLAT+158)
(*
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(*             DEFINE REGION 56
(*
 REG3D (56,PLAT+202,PLAT+94 ,PLAT+249,PLAT+250,PLAT+251,PLAT+252, &
        PLAT+148,PLAT+153,PLAT+140,PLAT+149,PLAT+221,PLAT+224, &
        PLAT+222,PLAT+206,PLAT+205,PLAT+223,PLAT+225,PLAT+207, &
        PLAT+67 ,PLAT+68 ,PLAT+2  ,PLAT+72 ,PLAT+99 ,PLAT+100, &
        PLAT+107,PLAT+108)
(*
(*             DEFINE REGION 57
(*
 REG3D (57,PLAT+249,PLAT+206,PLAT+253,PLAT+254,PLAT+255,PLAT+256, &
        PLAT+82 ,PLAT+154,PLAT+155,PLAT+153,PLAT+239,PLAT+233, &
        PLAT+240,PLAT+224,PLAT+223,PLAT+232,PLAT+234,PLAT+225, &
        PLAT+2  ,PLAT+6  ,PLAT+72 ,PLAT+74 ,PLAT+107,PLAT+108, &
        PLAT+113,PLAT+114)
(*
(*             DEFINE REGION 58
(*
 REG3D (58,PLAT+211,PLAT+253,PLAT+257,PLAT+258,PLAT+259,PLAT+260, &
        PLAT+90 ,PLAT+158,PLAT+159,PLAT+154,PLAT+245,PLAT+256, &
        PLAT+246,PLAT+233,PLAT+232,PLAT+255,PLAT+234,PLAT+257, &
        PLAT+6  ,PLAT+74 ,PLAT+10 ,PLAT+76 ,PLAT+113,PLAT+114, &
        PLAT+119,PLAT+120)
(*
(*             DEFINE REGION 59
(*
 REG3D (59,PLAT+216,PLAT+257,PLAT+261,PLAT+262,PLAT+263,PLAT+264, &
        PLAT+98 ,PLAT+162,PLAT+163,PLAT+158,PLAT+262,PLAT+273, &
        PLAT+263,PLAT+256,PLAT+255,PLAT+272,PLAT+274,PLAT+257, &
        PLAT+10 ,PLAT+76 ,PLAT+14 ,PLAT+78 ,PLAT+119,PLAT+120, &
        PLAT+125,PLAT+126)
(*
(*             DEFINE REGION 60
(*
 REG3D (60,PLAT+261,PLAT+221,PLAT+265,PLAT+266,PLAT+267,PLAT+268, &
        PLAT+106,PLAT+166,PLAT+167,PLAT+162,PLAT+279,PLAT+290, &
        PLAT+280,PLAT+273,PLAT+272,PLAT+289,PLAT+291,PLAT+274, &
        PLAT+14 ,PLAT+78 ,PLAT+18 ,PLAT+80 ,PLAT+125,PLAT+126, &
        PLAT+131,PLAT+132)
(*
(*             DEFINE REGION 61
(*
 REG3D (61,PLAT+265,PLAT+226,PLAT+269,PLAT+270,PLAT+271,PLAT+272, &
        PLAT+114,PLAT+170,PLAT+171,PLAT+166,PLAT+296,PLAT+307, &
        PLAT+297,PLAT+290,PLAT+289 PLAT+306,PLAT+308,PLAT+291, &
        PLAT+18 ,PLAT+80 ,PLAT+22 ,PLAT+82 ,PLAT+131,PLAT+132, &
        PLAT+137,PLAT+138)
(*
(*             DEFINE REGION 62
(*
 REG3D (62,PLAT+269,PLAT+231,PLAT+273,PLAT+274,PLAT+275,PLAT+276, &
        PLAT+122,PLAT+174,PLAT+175,PLAT+170,PLAT+313,PLAT+324, &
        PLAT+314,PLAT+307,PLAT+306,PLAT+323,PLAT+325,PLAT+308, &
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        PLAT+22 .PLAT+82 .PLAT+26 .PLAT+84  PLAT+137 PLAT+138. &
        PLAT+143.PLAT+144)
(*
(*              DEFINE REGION 63
(*
  REG3D (63.PLAT+273.PLAT+236.PLAT+277.PLAT+278.PLAT+279,PLAT+280. &
        PLAT+130 PLAT+178.PLAT+179 PLAT+174 PLAT+809.PLAT+335. &
        PLAT+812.PLAT+324.PLAT+323.PLAT+334 PLAT+336.PLAT+325. &
        PLAT+26 .PLAT+84 .PLAT+30 .PLAT+86 .PLAT+143,PLAT+144. &
        PLAT+149.PLAT+150)
(*
(*              DEFINE REGION 64
(*
  REG3D (64,PLAT+277,PLAT+241.PLAT+281,PLAT+282,PLAT+283,PLAT+284, &
        PLAT+188.PLAT+189.PLAT+190,PLAT+178.PLAT+341,PLAT+352, &
        PLAT+342.PLAT+335.PLAT+334,PLAT+350.PLAT+353,PLAT+336, &
        PLAT+30 ,PLAT+86 ,PLAT+91 .PLAT+92  PLAT+149.PLAT+150. &
        PLAT+155.PLAT+156)
(*
(*              DEFINE REGION 65
(*
  REG3D (65.PLAT+281.PLAT+246.PLAT+285.PLAT+286,PLAT+287,PLAT+288. &
        PLAT+194.PLAT+195.PLAT+196.PLAT+189.PLAT+356.PLAT+361, &
        PLAT+813.PLAT+352.PLAT+350.PLAT+358.PLAT+362.PLAT+353. &
        PLAT+91 .PLAT+92 .PLAT+94 .PLAT+95 .PLAT+155.PLAT+156. &
        PLAT+158.PLAT+159)
(*
(*              DEFINE REGION 66
(*
  REG3D (66.PLAT+285.PLAT+245.PLAT+289.PLAT+290.PLAT+291.PLAT+292. &
        PLAT+199.PLAT+197.PLAT+198.PLAT+195.PLAT+359.PLAT+360, &
        PLAT+363.PLAT+361.PLAT+358.PLAT+357.PLAT+364.PLAT+362, &
        PLAT+94 .PLAT+93 .PLAT+95 .PLAT+96 ,PLAT+158,PLAT+159. &
        PLAT+157.PLAT+160)
(*
(*              DEFINE REGION 67
(*
  REG3D (67,PLAT+136.PLAT+244.PLAT+289.PLAT+293.PLAT+294.PLAT+295. &
        PLAT+181.PLAT+192,PLAT+193.PLAT+197.PLAT+343.PLAT+354. &
        PLAT+355.PLAT+360.PLAT+805.PLAT+344.PLAT+357.PLAT+364. &
        PLAT+87 .PLAT+88 .PLAT+93 .PLAT+96 .PLAT+151.PLAT+152. &
        PLAT+157.PLAT+160)
(*
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
(*******************************************************************
(*******************************************************************
(*
(*                  DEFINE THE TIP CAP
(*
(*******************************************************************
(*******************************************************************
(*
  DELETEPT (801)
  DELETEPT (802)
  DELETEPT (803)
  DELETEPT (804)
  DELETEPT (805)
  DELETEPT (806)
  DELETEPT (807)
  DELETEPT (808)
(*
  DELETECV (900)
  DELETECV (901)
  DELETECV (902)
  DELETECV (903)
(*
  POINT(801,XLED1,YLED1,ZVAL3)
  POINT(802,XTED1,YTED1,ZVAL3)
  POINT(803,CXLED,CYLED,ZVAL3)
  POINT(804,CXTED,CYTED,ZVAL3)
  POINT(805,XINNER,YCENTER,ZVAL3)
  POINT(806,XOUTER,YCENTER,ZVAL3)
  POINT(807,CXINER,CYCNTR,ZVAL3)
  POINT(808,CXOTER,CYCNTR,ZVAL3)
(*
  ARC(900,806,801,802)
  ARC(901,805,801,802)
  ARC(902,808,803,804)
  ARC(903,807,803,804)
(*
  PARMCRV (TIP+245,901,.05)
  PARMCRV (TIP+246,900,.05)
  PARMCRV (TIP+247,903,.05)
  PARMCRV (TIP+248,902,.05)
  PARMCRV (TIP+249,901,(POS1+.05))
(*
  PARMCRV (TIP+250,903,POS1)
  PARMCRV (TIP+251,902,POS1)
  PARMCRV (TIP+252,900,(POS1+.05))
  PARMCRV (TIP+253,901,(WPOS1+.05))
  PARMCRV (TIP+254,903,WPOS1)
  PARMCRV (TIP+255,902,WPOS1)
  PARMCRV (TIP+256,900,(WPOS1+.05))
  PARMCRV (TIP+257,901,(POS2+.05))
  PARMCRV (TIP+258,903,POS2)
  PARMCRV (TIP+259,902,POS2)
```

```
(*
  PARMCRV  (TIP+260.900.(POS2+.05))
  PARMCRV  (TIP+261.901.(WPOS2+.05))
  PARMCRV  (TIP+262.903.WPOS2)
  PARMCRV  (TIP+263.902.WPOS2)
  PARMCRV  (TIP+264.900.(WPOS2+.05))
  PARMCRV  (TIP+265.901.POS3)
  PARMCRV  (TIP+266.903.POS3)
  PARMCRV  (TIP+267.902.POS3)
  PARMCRV  (TIP+268.900.POS3)
  PARMCRV  (TIP+269.901.WPOS3)
(*
  PARMCRV  (TIP+270.903.WPOS3)
  PARMCRV  (TIP+271.902.WPOS3)
  PARMCRV  (TIP+272.900.WPOS3)
  PARMCRV  (TIP+273.901.(POS4-.05))
  PARMCRV  (TIP+274.903.POS4)
  PARMCRV  (TIP+275.902.POS4)
  PARMCRV  (TIP+276.900.(POS4-.05))
  PARMCRV  (TIP+277.901.(WPOS4-.05))
  PARMCRV  (TIP+278.903.WPOS4)
  PARMCRV  (TIP+279.902.WPOS4)
(*
  PARMCRV  (TIP+280.900.(WPOS4-.05))
  PARMCRV  (TIP+281.903..97)
  PARMCRV  (TIP+282.902,.97)
  PARMCRV  (TIP+283.901,.90)
  PARMCRV  (TIP+284.900,.90)
  PARMCRV  (TIP+285.901,.97)
  PARMCRV  (TIP+286.900,.97)
(*.
(*
(* CONSTRUCT TEMPORARY POINTS NEEDED TO DEFINE CURVES
(*
  PARMCRV  (900.900.(POS1/2))
  PARMCRV  (901.900.(POS1+WPOS1+.1)/2)
  PARMCRV  (902.900.(WPOS1+POS2+.1)/2)
  PARMCRV  (903.900.(POS2+WPOS2+.1)/2)
  PARMCRV  (904.900.(WPOS2+POS3+.05)/2)
  PARMCRV  (905.900.(POS3+WPOS3)/2)
  PARMCRV  (906.900.(WPOS3+POS4)/2)
  PARMCRV  (907.900.(POS4+WPOS4-.1)/2)
  PARMCRV  (908 900.(WPOS4+.90)/2)
  PARMCRV  (909.900..935)
(*
  PARMCRV  (910,902.(POS1/2))
  PARMCRV  (911,902,(POS1+WPOS1)/2)
  PARMCRV  (912,902,(WPOS1+POS2)/2)
  PARMCRV  (913,902,(POS2+WPOS2)/2)
  PARMCRV  (914,902,(WPOS2+POS3)/2)
  PARMCRV  (915,902,(POS3+WPOS3)/2)
  PARMCRV  (916,902,(WPOS3+POS4)/2)
  PARMCRV  (917,902,(POS4+WPOS4)/2)
```

```
 PARMCRV (918.902.(WPOS4+.97)/2)
(*
 PARMCRV (919.903.(POS1/2))
 PARMCRV (920.903.(POS1+WPOS1)/2)
 PARMCRV (921.903.(WPOS1+POS2)/2)
 PARMCRV (922.903.(POS2+WPOS2)/2)
 PARMCRV (923.903.(WPOS2+POS3)/2)
 PARMCRV (924.903.(POS3+WPOS3)/2)
 PARMCRV (925.903.(WPOS3+POS4)/2)
 PARMCRV (926.903.(POS4+WPOS4)/2)
 PARMCRV (927.903.(WPOS4+.97)/2)
(*
 PARMCRV (928.901.(POS1/2))
 PARMCRV (929.901.(POS1+WPOS1+.1)/2)
 PARMCRV (930.901.(WPOS1+POS2+.1)/2)
 PARMCRV (931.901.(POS2+WPOS2+.1)/2)
 PARMCRV (932.901.(WPOS2+POS3+.05)/2)
 PARMCRV (933.901.(POS3+WPOS3)/2)
 PARMCRV (934.901.(WPOS3+POS4)/2)
 PARMCRV (935.901.(POS4+WPOS4-.1)/2)
 PARMCRV (936.901.(WPOS4+.90)/2)
 PARMCRV (937.901..935)
(*
(*******************************************************************
(*                                                                 *
(*               - TIP CAP CURVE DEFINITIONS -                     *
(*                  DEFINE ESMOSS CURVES                           *
(*                                                                 *
(*******************************************************************
(*
(*
  LTIP = 0
  LINE (LTIP+587,BLAD+203,TIP+245)
  LINE (LTIP+588,BLAD+204,TIP+246)
  LINE (LTIP+589,TIP+245 ,TIP+246)
  LINE (LTIP+590,BLAD+205,TIP+247)
  LINE (LTIP+591,TIP+247 ,TIP+248)
  LINE (LTIP+592,BLAD+206,TIP+248)
  ARCCF(LTIP+593,TIP+245,TIP+249,928)
  LINE (LTIP+594,TIP+247,TIP+250)
  LINE (LTIP+595,TIP+248,TIP+251)
  ARCCF(LTIP+596,TIP+246,TIP+252,900)
  LINE (LTIP+597,BLAD+207,TIP+249)
  LINE (LTIP+598,TIP+249 ,TIP+250)
  LINE (LTIP+599,BLAD+208,TIP+250)
  LINE (LTIP+600,TIP+250 ,TIP+251)
 (*
  LINE (LTIP+601,BLAD+209,TIP+251)
  LINE (LTIP+602,TIP+251 ,TIP+252)
  LINE (LTIP+603,BLAD+210,TIP+252)
  LINE (LTIP+604,TIP+249,TIP+253)
  LINE (LTIP+605,TIP+250,TIP+254)
  LINE (LTIP+606,TIP+251,TIP+255)
```

```
 LINE (LTIP+607.TIP+252.TIP+256)
 LINE (LTIP+608.BLAD+211.TIP+253)
 LINE (LTIP+609.TIP+253 .TIP+254)
 LINE (LTIP+610.BLAD+212.TIP+254)
(*
 LINE (LTIP+611.TIP+254 .TIP+255)
 LINE (LTIP+612.BLAD+213.TIP+255)
 LINE (LTIP+613.TIP+255 .TIP+256)
 LINE (LTIP+614.BLAD+214.TIP+256)
 ARCCF(LTIP+615,TIP+253,TIP+257.930)
 LINE (LTIP+616.TIP+254.TIP+258)
 LINE (LTIP+617.TIP+255,TIP+259)
 ARCCF(LTIP+618.TIP+256,TIP+260,902)
 LINE (LTIP+619.BLAD+215,TIP+257)
(*
 LINE (LTIP+620.TIP+257 .TIP+258)
 LINE (LTIP+621.BLAD+216.TIP+258)
 LINE (LTIP+622.TIP+258 ,TIP+259)
 LINE (LTIP+623.BLAD+217.TIP+259)
 LINE (LTIP+624.TIP+259 .TIP+260)
 LINE (LTIP+625.BLAD+218.TIP+260)
 LINE (LTIP+626.TIP+257,TIP+261)
 LINE (LTIP+627.TIP+258,TIP+262)
 LINE (LTIP+628.TIP+259.TIP+263)
 LINE (LTIP+629.TIP+260.TIP+264)
(*
 LINE (LTIP+630.BLAD+219.TIP+261)
 LINE (LTIP+631.TIP+261 ,TIP+262)
 LINE (LTIP+632.BLAD+220.TIP+262)
 LINE (LTIP+633.TIP+262 .TIP+263)
 LINE (LTIP+634.BLAD+221.TIP+263)
 LINE (LTIP+635.TIP+263 .TIP+264)
 LINE (LTIP+636.BLAD+222.TIP+264)
 ARCCF(LTIP+637.TIP+261,TIP+265.932)
 LINE (LTIP+638.TIP+262,TIP+266)
 LINE (LTIP+639.TIP+263,TIP+267)
(*
 ARCCF(LTIP+640.TIP+264.TIP+268.904)
 LINE (LTIP+641.BLAD+2[illegible]3.TIP+265)
 LINE (LTIP+642.TIP+26[illegible]  TIP+266)
 LINE (LTIP+643 BLAD+[illegible] TIP+266)
 LINE (LTIP+644.TIP+266  .TIP+267)
 LINE (LTIP+645.BLAD+225.TIP+267)
 LINE (LTIP+646.TIP+267 .TIP+268)
 LINE (LTIP+647.BLAD+226,TIP+268)
 LINE (LTIP+648,TIP+265,TIP+269)
 LINE (LTIP+649.TIP+266,TIP+270)
(*
 LINE (LTIP+650,TIP+267,TIP+271)
 LINE (LTIP+651,TIP+268,TIP+272)
 LINE (LTIP+652,BLAD+227,TIP+269)
 LINE (LTIP+653,TIP+269 ,TIP+270)
 LINE (LTIP+654,BLAD+228,TIP+270)
```

```
 LINE (LTIP+655.TIP+270 .TIP+271)
 LINE (LTIP+656.BLAD+229.TIP+271)
 LINE (LTIP+657.TIP+271 .TIP+272)
 LINE (LTIP+658.BLAD+230.TIP+272)
 ARCCF(LTIP+659.TIP+269.TIP+273.934)
(*
 LINE (LTIP+660.TIP+270.TIP+274)
 LINE (LTIP+661.TIP+271.TIP+275)
 ARCCF(LTIP+662,TIP+272,TIP+276.906)
 LINE (LTIP+663.BLAD+231,TIP+273)
 LINE (LTIP+664.TIP+273 ,TIP+274)
 LINE (LTIP+665.BLAD+232.TIP+274)
 LINE (LTIP+666.TIP+274 .TIP+275)
 LINE (LTIP+667.BLAD+233.TIP+275)
 LINE (LTIP+668.TIP+275 .TIP+276)
 LINE (LTIP+669.BLAD+234.TIP+276)
(*
 LINE (LTIP+670.TIP+273.TIP+277)
 LINE (LTIP+671.TIP+274.TIP+278)
 LINE (LTIP+672.TIP+275.TIP+279)
 LINE (LTIP+673.TIP+276.TIP+280)
 LINE (LTIP+674.BLAD+235.TIP+277)
 LINE (LTIP+675.TIP+277 ,TIP+278)
 LINE (LTIP+676.BLAD+236,TIP+278)
 LINE (LTIP+677.TIP+278 ,TIP+279)
 LINE (LTIP+678.BLAD+237,TIP+279)
 LINE (LTIP+679.TIP+279 ,TIP+280)
(*
 LINE (LTIP+680.BLAD+238.TIP+280)
 ARCCF(LTIP+681.TIP+277.TIP+283.936)
 LINE (LTIP+682,TIP+278,TIP+281)
 LINE (LTIP+683.TIP+279.TIP+282)
 ARCCF(LTIP+684.TIP+280.TIP+284.908)
 LINE (LTIP+685.BLAD+239.TIP+281)
 LINE (LTIP+686.BLAD+240.TIP+282)
 LINE (LTIP+687.TIP+281 .TIP+283)
 LINE (LTIP+688.TIP+282 .TIP+284)
 LINE (LTIP+689.TIP+281 .TIP+282)
(*
 LINE (LTIP+690.BLAD+241 TIP+283)
 LINE (LTIP+691.TIP+283 .TIP+284)
 LINE (LTIP+692.BLAD+242 TIP+284)
 ARCCF(LTIP+693.TIP+283.TIP+285.937)
 ARCCF(LTIP+694.TIP+284.TIP+286.909)
 LINE (LTIP+695.TIP+285 .TIP+286)
 LINE (LTIP+696.BLAD+243.TIP+285)
 LINE (LTIP+697.BLAD+244.TIP+286)
(*
 LINE (LTIP+819.TIP+246 ,TIP+248)
 LINE (LTIP+820.TIP+245 .TIP+247)
(*
(* DELETE TEMPORARY POINTS THAT WERE CONSTRUCTED
(*
```

```
 DELETEPT (900)
 DELETEPT (901)
 DELETEPT (902)
 DELETEPT (903)
 DELETEPT (904)
 DELETEPT (905)
 DELETEPT (906)
 DELETEPT (907)
 DELETEPT (908)
 DELETEPT (909)
(*
 DELETEPT (910)
 DELETEPT (911)
 DELETEPT (912)
 DELETEPT (913)
 DELETEPT (914)
 DELETEPT (915)
 DELETEPT (916)
 DELETEPT (917)
 DELETEPT (918)
 DELETEPT (919)
(*
 DELETEPT (920)
 DELETEPT (921)
 DELETEPT (922)
 DELETEPT (923)
 DELETEPT (924)
 DELETEPT (925)
 DELETEPT (926)
 DELETEPT (927)
 DELETEPT (928)
 DELETEPT (929)
(*
 DELETEPT (930)
 DELETEPT (931)
 DELETEPT (932)
 DELETEPT (933)
 DELETEPT (934)
 DELETEPT (935)
 DELETEPT (936)
 DELETEPT (937)
(*
(*
(*******************************************************************
(*                                                                 *
(*               - TIP CAP SURFACE DEFINITIONS -                   *
(*                  DEFINE ESMOSS SURFACES                         *
(*                                                                 *
(*******************************************************************
(*
  STIP = 0
(*
(* SURFACES FOR REGION 118
```

```
(*
  RULEDSRF (STIP+530,LBLD+478,LTIP+589)
  RULEDSRF (STIP+531,LBLD+816,LTIP+820)
  RULEDSRF (STIP+532,LBLD+817,LTIP+819)
  RULEDSRF (STIP+533,LBLD+481,LTIP+591)
  RULEDSRF (STIP+534,LTIP+591,LTIP+589)
(*
(* SURFACES FOR REGION 119
(*
  RULEDSRF (STIP+535,LBLD+483,LTIP+593)
  RULEDSRF (STIP+536,LBLD+488,LTIP+598)
  RULEDSRF (STIP+537,LBLD+484,LTIP+594)
  RULEDSRF (STIP+538,LTIP+593,LTIP+594)
(*
(* SURFACES FOR REGION 120
(*
  RULEDSRF (STIP+539,LBLD+494,LTIP+604)
  RULEDSRF (STIP+540,LBLD+499,LTIP+609)
  RULEDSRF (STIP+541,LBLD+495,LTIP+605)
  RULEDSRF (STIP+542,LTIP+604,LTIP+605)
(*
(* SURFACES FOR REGION 121
(*
  RULEDSRF (STIP+543,LBLD+505,LTIP+615)
  RULEDSRF (STIP+544,LBLD+510,LTIP+620)
  RULEDSRF (STIP+545,LBLD+506,LTIP+616)
  RULEDSRF (STIP+546,LTIP+615,LTIP+616)
(*
(* SURFACES FOR REGION 122
(*
  RULEDSRF (STIP+547,LBLD+516,LTIP+626)
  RULEDSRF (STIP+548,LBLD+521,LTIP+631)
  RULEDSRF (STIP+549,LBLD+517,LTIP+627)
  RULEDSRF (STIP+550,LTIP+626,LTIP+627)
(*
(* SURFACES FOR REGION 123
(*
  RULEDSRF (STIP+551,LBLD+527,LTIP+637)
  RULEDSRF (STIP+552,LBLD+532,LTIP+642)
  RULEDSRF (STIP+553,LBLD+528,LTIP+638)
  RULEDSRF (STIP+554,LTIP+637,LTIP+638)
(*
(* SURFACES FOR REGION 124
(*
  RULEDSRF (STIP+555,LBLD+538,LTIP+648)
  RULEDSRF (STIP+556,LBLD+543,LTIP+653)
  RULEDSRF (STIP+557,LBLD+539,LTIP+649)
  RULEDSRF (STIP+558,LTIP+648,LTIP+649)
(*
(* SURFACES FOR REGION 125
(*
  RULEDSRF (STIP+559,LBLD+549,LTIP+659)
  RULEDSRF (STIP+560,LBLD+554,LTIP+664)
```

```
  RULEDSRF (STIP+561.LBLD+550.LTIP+660)
  RULEDSRF (STIP+562.LTIP+659.LTIP+660)
(*
(* SURFACES FOR REGION 126
(*
  RULEDSRF (STIP+563.LBLD+560.LTIP+670)
  RULEDSRF (STIP+564.LBLD+565.LTIP+675)
  RULEDSRF (STIP+565.LBLD+561.LTIP+671)
  RULEDSRF (STIP+566.LTIP+670.LTIP+671)
(*
(* SURFACES FOR REGION 127
(*
  RULEDSRF (STIP+567.LBLD+570.LTIP+681)
  RULEDSRF (STIP+568.LBLD+577.LTIP+687)
  RULEDSRF (STIP+569.LBLD+571.LTIP+682)
  RULEDSRF (STIP+570.LTIP+681.LTIP+682)
(*
(* SURFACES FOR REGION 128
(*
  RULEDSRF (STIP+571.LBLD+484.LTIP+594)
  RULEDSRF (STIP+572.LBLD+490.LTIP+600)
  RULEDSRF (STIP+573.LBLD+485.LTIP+595)
  RULEDSRF (STIP+574.LTIP+594.LTIP+595)
  RULEDSRF (STIP+999.LTIP+484.LTIP+485)
(*
(* SURFACES FOR REGION 129
(*
  RULEDSRF (STIP+575.LBLD+495.LTIP+605)
  RULEDSRF (STIP+576.LBLD+501.LTIP+611)
  RULEDSRF (STIP+577.LBLD+496.LTIP+606)
  RULEDSRF (STIP+578.LTIP+600.LTIP+611)
(*
(* SURFACES FOR REGION 130
(*
  RULEDSRF (STIP+579.LBLD+506.LTIP+616)
  RULEDSRF (STIP+580.LBLD+512.LTIP+622)
  RULEDSRF (STIP+581.LBLD+507.LTIP+617)
  RULEDSRF (STIP+582.LTIP+616.LTIP+617)
  RULEDSRF (STIP+583.LTIP+506.LTIP+507)
(*
(* SURFACES FOR REGION 131
(*
  RULEDSRF (STIP+584.LBLD+523 LTIP+633)
  RULEDSRF (STIP+585.LBLD+518.LTIP+628)
  RULEDSRF (STIP+586.LBLD+627.LTIP+628)
(*
(* SURFACES FOR REGION 132
(*
  RULEDSRF (STIP+587.LBLD+528.LTIP+638)
  RULEDSRF (STIP+588.LBLD+534.LTIP+644)
  RULEDSRF (STIP+589.LBLD+529.LTIP+639)
  RULEDSRF (STIP+590.LTIP+638.LTIP+639)
  RULEDSRF (STIP+591.LTIP+528.LTIP+529)
```

```
(*
(* SURFACES FOR REGION 133
(*
  RULEDSRF (STIP+592,LBLD+545,LTIP+655)
  RULEDSRF (STIP+593,LBLD+540,LTIP+650)
  RULEDSRF (STIP+594,LBLD+649,LTIP+650)
(*
(* SURFACES FOR REGION 134
(*
  RULEDSRF (STIP+595,LBLD+556,LTIP+666)
  RULEDSRF (STIP+596,LBLD+551,LTIP+661)
  RULEDSRF (STIP+597,LBLD+550,LBLD+551)
  RULEDSRF (STIP+598,LTIP+660,LTIP+661)
(*
(* SURFACES FOR REGION 135
(*
  RULEDSRF (STIP+599,LBLD+566,LTIP+677)
  RULEDSRF (STIP+600,LBLD+562,LTIP+672)
  RULEDSRF (STIP+601,LBLD+671,LTIP+672)
(*
(* SURFACES FOR REGION 136
(*
  RULEDSRF (STIP+602,LBLD+576,LTIP+689)
  RULEDSRF (STIP+603,LBLD+572,LTIP+683)
  RULEDSRF (STIP+604,LBLD+571,LBLD+572)
  RULEDSRF (STIP+605,LTIP+682,LTIP+683)
(*
(* SURFACES FOR REGION 137
(*
  RULEDSRF (STIP+606,LBLD+492,LTIP+602)
  RULEDSRF (STIP+607,LBLD+486,LTIP+596)
  RULEDSRF (STIP+608,LTIP+595,LTIP+596)
(*
(* SURFACES FOR REGION 138
(*
  RULEDSRF (STIP+609,LBLD+503,LTIP+613)
  RULEDSRF (STIP+610,LBLD+497,LTIP+607)
  RULEDSRF (STIP+611,LTIP+606,LTIP+607)
(*
(* SURFACES FOR REGION 139
(*
  RULEDSRF (STIP+612,LBLD+514,LTIP+624)
  RULEDSRF (STIP+613,LBLD+508,LTIP+618)
  RULEDSRF (STIP+614,LTIP+617,LTIP+618)
(*
(* SURFACES FOR REGION 140
(*
  RULEDSRF (STIP+615,LBLD+525,LTIP+635)
  RULEDSRF (STIP+616,LBLD+519,LTIP+629)
  RULEDSRF (STIP+617,LTIP+628,LTIP+629)
(*
(* SURFACES FOR REGION 141
(*
```

```
  RULEDSRF (STIP+618.LBLD+536.LTIP-646)
  RULEDSRF (STIP+619.LBLD+530.LTIP+640)
  RULEDSRF (STIP+620.LTIP+639.LTIP+640)
(*
(* SURFACES FOR REGION 142
(*
  RULEDSRF (STIP+621.LBLD+547.LTIP+657)
  RULEDSRF (STIP+622.LBLD+541.LTIP+651)
  RULEDSRF (STIP+623.LTIP+650.LTIP+651)
(*
(* SURFACES FOR REGION 143
(*
  RULEDSRF (STIP+624.LBLD+558,LTIP+668) .
  RULEDSRF (STIP+625.LBLD+552.LTIP+662)
  RULEDSRF (STIP+626,LTIP+661.LTIP+662)
(*
(* SURFACES FOR REGION 144
(*
  RULEDSRF (STIP+627,LBLD+568,LTIP+679)
  RULEDSRF (STIP+628,LBLD+563,LTIP+673)
  RULEDSRF (STIP+629,LTIP+672,LBLD+673)
(*
(* SURFACES FOR REGION 145
(*
  RULEDSRF (STIP+630.LBLD+578,LTIP+688)
  RULEDSRF (STIP+631.LBLD+573.LTIP+684)
  RULEDSRF (STIP+632,LTIP+683.LTIP+684)
(*
(* SURFACES FOR REGION 146
(*
  RULEDSRF (STIP+633,LBLD+581.LTIP+691)
  RULEDSRF (STIP+634,LTIP+689.LTIP+691)
(*
(* SURFACES FOR REGION 147
(*
  RULEDSRF (STIP+635.LBLD+582.LTIP+693)
  RULEDSRF (STIP+636.LBLD+583.LTIP+694)
  RULEDSRF (STIP+637.LBLD+586.LTIP+695)
  RULEDSRF (STIP+638.LTIP+693.LTIP+694)
(*
(*****************************************************************
(*                                                               *
(*              - TIP CAP REGION DEFINITIONS -                   *
(*                 DEFINE ESMOSS REGIONS                         *
(*                                                               *
(*****************************************************************
(*
(*            DEFINE REGION 118
(*
  REG3D(118,STIP+530,STIP+531,STIP+532,STIP+533.STIP+534,SBLD+434, &
          LBLD+816,LBLD+481.LBLD+817,LBLD+478.LTIP+820.LTIP+591, &
          LTIP+819,LTIP+589,LTIP+587,LTIP+588.LTIP+590,LTIP+592, &
          BLAD+203,BLAD+204.BLAD+205,BLAD+206.TIP+245,TIP+246, &
```

```
      TIP+247.TIP+248)
(*
(*              DEFINE REGION 119
(*
 REG3D(119.STIP+531.STIP+535.STIP+536.STIP+537.STIP+538.SBLD+438. &
      LBLD+483.LBLD+488.LBLD+484.LBLD+816.LTIP+593.LTIP+598. &
      LTIP+594.LTIP+820.LTIP+587.LTIP+597.LTIP+599.LTIP+590. &
      BLAD+203.BLAD+205.BLAD+207.BLAD+208.TIP+245.TIP+247. &
      TIP+249.TIP+250)
(*
(*              DEFINE REGION 120
(*
 REG3D(120,STIP+536,STIP+539.STIP+540,STIP+541.STIP+542.SBLD+442. &
      LBLD+494.LBLD+499.LBLD+495.LBLD+488.LTIP+604.LTIP+609. &
      LTIP+605.LTIP+598.LTIP+597.LTIP+608.LTIP+610.LTIP+599. &
      BLAD+207.BLAD+208.BLAD+211,BLAD+212.TIP+249.TIP+250. &
      TIP+253.TIP+254)
(*
(*              DEFINE REGION 121
(*
 REG3D(121,STIP+540.STIP+543.STIP+544.STIP+545.STIP+546.SBLD+446. &
      LBLD+505,LBLD+510,LBLD+506,LBLD+499.LTIP+615.LTIP+620. &
      LTIP+616,LTIP+609,LTIP+608.LTIP+619.LTIP+621,LTIP+610. &
      BLAD+211.BLAD+212.BLAD+215.BLAD+216.TIP+253.TIP+254. &
      TIP+257.TIP+258)
(*
(*              DEFINE REGION 122
(*
 REG3D(122.STIP+544.STIP+547.STIP+548.STIP+549.STIP+550.SBLD+450. &
      LBLD+516.LBLD+521.LBLD+517.LBLD+510.LTIP+626.LTIP+631. &
      LTIP+627.LTIP+620.LTIP+619.LTIP+630.LTIP+632.LTIP+621. &
      BLAD+215.BLAD+216.BLAD+219.BLAD+220.TIP+257.TIP+258. &
      TIP+261.TIP+262)
(*
(*              DEFINE REGION 123
(*
 REG3D(123,STIP+548.STIP+551.STIP+552.STIP+553.STIP+554,SBLD+454. &
      LBLD+527.LBLD+532.LBLD+528.LBLD+521.LTIP+637,LTIP+642. &
      LTIP+638.LTIP+631.LTIP+630.LTIP+641.LTIP+643,LTIP+632. &
      BLAD+219.BLAD+220.BLAD+223.BLAD+224.TIP+261,TIP+262. &
      TIP+265.TIP+266)
(*
(*              DEFINE REGION 124
(*
 REG3D(124,STIP+552,STIP+555,STIP+556.STIP+557,STIP+558.SBLD+458. &
      LBLD+538,LBLD+543.LBLD+539.LBLD+532.LTIP+648.LTIP+653. &
      LTIP+649,LTIP+642.LTIP+641.LTIP+652.LTIP+654,LTIP+643. &
      BLAD+223.BLAD+224.BLAD+227.BLAD+228.TIP+265.TIP+266. &
      TIP+269.TIP+270)
(*
(*              DEFINE REGION 125
(*
 REG3D(125,STIP+556,STIP+559,STIP+560.STIP+561.STIP+562.SBLD+462. &
```

```
        LBLD+549,LBLD+554,LBLD+550,LBLD+543,LTIP+659,LTIP+664, &
        LTIP+660,LTIP+653,LTIP+652,LTIP+663,LTIP+665,LTIP+654, &
        BLAD+227,BLAD+228,BLAD+231,BLAD+[illegible],TIP+269,TIP+270, &
        TIP+273,TIP+274)
(*
(*           DEFINE REGION 126
(*
  REG3D(126,STIP+560,STIP+563,STIP+564,STIP+565,STIP+566,SBLD+466, &
        LBLD+560,LBLD+565,LBLD+561,LBLD+554,LTIP+670,LTIP+675, &
        LTIP+671,LTIP+664,LTIP+663,LTIP+674,LTIP+676,LTIP+665, &
        BLAD+231,BLAD+232,BLAD+235,BLAD+236,TIP+273,TIP+274, &
        TIP+277,TIP+278)
(*
(*           DEFINE REGION 127
(*
  REG3D(127,STIP+564,STIP+567,STIP+568,STIP+569,STIP+570,SBLD+470, &
        LBLD+570,LBLD+577,LBLD+571,LBLD+565,LTIP+681,LTIP+687, &
        LTIP+682,LTIP+675,LTIP+674,LTIP+690,LTIP+685,LTIP+676, &
        BLAD+235,BLAD+236,BLAD+241,BLAD+239,TIP+277,TIP+278, &
        TIP+281,TIP+283)
(*
(*           DEFINE REGION 128
(*
  REG3D(128,STIP+533,STIP+571,STIP+572,STIP+573,STIP+574,SBLD+999, &
        LBLD+484,LBLD+490,LBLD+485,LBLD+481,LTIP+594,LTIP+600, &
        LTIP+595,LTIP+591,LTIP+599,LTIP+601,LTIP+590,LTIP+592, &
        BLAD+205,BLAD+206,BLAD+208,BLAD+209,TIP+247,TIP+248, &
        TIP+250,TIP+251)
(*
(*           DEFINE REGION 129
(*
  REG3D(129,STIP+572,STIP+575,STIP+576,STIP+577,STIP+578,SBLD+474, &
        LBLD+495,LBLD+501,LBLD+496,LBLD+490,LTIP+605,LTIP+611, &
        LTIP+606,LTIP+600,LTIP+599,LTIP+610,LTIP+612,LTIP+601, &
        BLAD+208,BLAD+209,BLAD+212,BLAD+213,TIP+250,TIP+251, &
        TIP+254,TIP+255)
(*
(*           DEFINE REGION 130
(*
  REG3D(130,STIP+576,STIP+579,STIP+580,STIP+581,STIP+582,SBLD+583, &
        LBLD+506,LBLD+512,LBLD+507,LBLD+501,LTIP+616,LTIP+622, &
        LTIP+617,LTIP+611,LTIP+610,LTIP+621,LTIP+623,LTIP+612, &
        BLAD+212,BLAD+213,BLAD+216,BLAD+217,TIP+254,TIP+255, &
        TIP+258,TIP+259)
(*
(*           DEFINE REGION 131
(*
  REG3D(131,STIP+580,STIP+584,STIP+585,STIP+586,STIP+549,SBLD+478, &
        LBLD+517,LBLD+523,LBLD+518,LBLD+512,LTIP+627,LTIP+633, &
        LTIP+628,LTIP+622,LTIP+621,LTIP+632,LTIP+634,LTIP+623, &
        BLAD+216,BLAD+217,BLAD+220,BLAD+221,TIP+258,TIP+259, &
        TIP+262,TIP+263)
(*
```

```
(*
(*              DEFINE REGION 132
(*
 REG3D(132,STIP+584,STIP+587,STIP+588,STIP+589,STIP+590,SBLD+591, &
       LBLD+528,LBLD+534,LBLD+529,LBLD+523,LTIP+638,LTIP+644, &
       LTIP+639,LTIP+633,LTIP+632,LTIP+643,LTIP+645,LTIP+634, &
       BLAD+220,BLAD+221,BLAD+224,BLAD+225,TIP+262,TIP+263, &
       TIP+266,TIP+267)
(*
(*              DEFINE REGION 133
(*
 REG3D(133,STIP+588,STIP+592,STIP+593,STIP+594,STIP+557,SBLD+482, &
       LBLD+539,LBLD+545,LBLD+540,LBLD+534,LTIP+649,LTIP+655, &
       LTIP+650,LTIP+644,LTIP+643,LTIP+654,LTIP+656,LTIP+645, &
       BLAD+224,BLAD+225,BLAD+228,BLAD+229,TIP+266,TIP+267, &
       TIP+270,TIP+271)
(*
(*              DEFINE REGION 134
(*
 REG3D(134,STIP+561,STIP+592,STIP+595,STIP+596,STIP+597,SBLD+598, &
       LBLD+550,LBLD+556,LBLD+551,LBLD+545,LTIP+660,LTIP+666, &
       LTIP+661,LTIP+655,LTIP+654,LTIP+665,LTIP+667,LTIP+656, &
       BLAD+228,BLAD+229,BLAD+232,BLAD+233,TIP+270,TIP+271, &
       TIP+274,TIP+275)
(*
(*              DEFINE REGION 135
(*
 REG3D(135,STIP+595,STIP+565,STIP+599,STIP+600,STIP+601,SBLD+486, &
       LBLD+561,LBLD+566,LBLD+562,LBLD+556,LTIP+671,LTIP+677, &
       LTIP+672,LTIP+666,LTIP+665,LTIP+676,LTIP+678,LTIP+667, &
       BLAD+232,BLAD+233,BLAD+236,BLAD+237,TIP+274,TIP+275, &
       TIP+278,TIP+279)
(*
(*              DEFINE REGION 136
(*
 REG3D(136,STIP+599,STIP+569,STIP+602,STIP+603,STIP+604,SBLD+605, &
       LBLD+571,LBLD+576,LBLD+572,LBLD+566,LTIP+682,LTIP+689, &
       LTIP+683,LTIP+677,LTIP+676,LTIP+685,LTIP+686,LTIP+678, &
       BLAD+236,BLAD+237,BLAD+239,BLAD+240,TIP+278,TIP+279, &
       TIP+281,TIP+282)
(*
(*              DEFINE REGION 137
(*
 REG3D(137,STIP+532,STIP+573,STIP+606,STIP+607,STIP+608,SBLD+490, &
       LBLD+485,LBLD+492,LBLD+486,LBLD+817,LTIP+595,LTIP+602, &
       LTIP+596,LTIP+819,LTIP+592,LTIP+601,LTIP+603,LTIP+588, &
       BLAD+204,BLAD+206,BLAD+209,BLAD+210,TIP+246,TIP+248, &
       TIP+251,TIP+252)
(*
(*              DEFINE REGION 138
(*
 REG3D(138,STIP+606,STIP+577,STIP+609,STIP+610,STIP+611,SBLD+493, &
       LBLD+496,LBLD+503,LBLD+497,LBLD+492,LTIP+606,LTIP+613, &
       LTIP+607,LTIP+602,LTIP+601,LTIP+612,LTIP+614,LTIP+603, &
```

```
      BLAD+209,BLAD+210,BLAD+213,BLAD+214,TIP+251,TIP+252, &
      TIP+255,TIP+256)
(*
(*         DEFINE REGION 139
(*
 REG3D(139,STIP+609,STIP+581,STIP+612,STIP+613,STIP+614,SBLD+498, &
      LBLD+507,LBLD+514,LBLD+508,LBLD+503,LTIP+617,LTIP+624, &
      LTIP+618,LTIP+613,LTIP+612,LTIP+623,LTIP+625,LTIP+614, &
      BLAD+213,BLAD+214,BLAD+217,BLAD+218,TIP+255,TIP+256, &
      TIP+259,TIP+260)
(*
(*         DEFINE REGION 140
(*
 REG3D(140,STIP+612,STIP+585,STIP+615,STIP+616,STIP+617,SBLD+501, &
      LBLD+518,LBLD+525,LBLD+519,LBLD+514,LTIP+628,LTIP+635, &
      LTIP+629,LTIP+624,LTIP+623,LTIP+634,LTIP+636,LTIP+625, &
      BLAD+217,BLAD+218,BLAD+221,BLAD+222,TIP+259,TIP+260, &
      TIP+263,TIP+264)
(*
(*         DEFINE REGION 141
(*
 REG3D(141,STIP+615,STIP+589,STIP+618,STIP+619,STIP+620,SBLD+505, &
      LBLD+529,LBLD+536,LBLD+530,LBLD+525,LTIP+639,LTIP+646, &
      LTIP+640,LTIP+635,LTIP+634,LTIP+645,LTIP+647,LTIP+636, &
      BLAD+221,BLAD+222,BLAD+225,BLAD+226,TIP+263,TIP+264, &
      TIP+267,TIP+268)
(*
(*         DEFINE REGION 142
(*
 REG3D(142,STIP+618,STIP+593,STIP+621,STIP+622,STIP+623,SBLD+508, &
      LBLD+540,LBLD+547,LBLD+541,LBLD+536,LTIP+650,LTIP+657, &
      LTIP+651,LTIP+646,LTIP+645,LTIP+656,LTIP+658,LTIP+647, &
      BLAD+225,BLAD+226,BLAD+229,BLAD+230,TIP+267,TIP+268, &
      TIP+271,TIP+272)
(*
(*         DEFINE REGION 143
(*
 REG3D(143,STIP+621,STIP+596,STIP+624,STIP+625,STIP+626,SBLD+512, &
      LBLD+551,LBLD+558,LBLD+552,LBLD+547,LTIP+661,LTIP+662, &
      LTIP+668,LTIP+657,LTIP+656,LTIP+667,LTIP+669,LTIP+658, &
      BLAD+229,BLAD+230,BLAD+233,BLAD+234,TIP+271,TIP+272, &
      TIP+275,TIP+276)
(*
(*         DEFINE REGION 144
(*
 REG3D(144,STIP+624,STIP+600,STIP+627,STIP+628,STIP+629,SBLD+515, &
      LBLD+562,LBLD+568,LBLD+563,LBLD+558,LTIP+672,LTIP+679, &
      LTIP+673,LTIP+668,LTIP+667,LTIP+678,LTIP+680,LTIP+669, &
      BLAD+233,BLAD+234,BLAD+237,BLAD+238,TIP+275,TIP+276, &
      TIP+279,TIP+280)
(*
(*         DEFINE REGION 145
(*
```

```
REG3D(145,STIP+627,STIP+603,STIP+630,STIP+631,STIP+632,SBLD+519, &
        LBLD+572 LBLD+578,LBLD+573,LBLD+568,LTIP+683,LTIP+688, &
        LTIP+684,LTIP+679,LTIP+678,LTIP+686,LTIP+692 LTIP+680, &
        BLAD+237,BLAD+238,BLAD+240,BLAD+242,TIP+279,TIP+280, &
        TIP+282,TIP+284)
(*
(*            DEFINE REGION 146
(*
REG3D(146,STIP+602,STIP+568,STIP+630,STIP+633,STIP+634,SBLD+522, &
        LBLD+576,LBLD+577,LBLD+581,LBLD+578,LTIP+687,LTIP+691, &
        LTIP+688,LTIP+689,LTIP+685,LTIP+690,LTIP+692,LTIP+686, &
        BLAD+240,BLAD+242,BLAD+239,BLAD+241,TIP+282,TIP+284, &
        TIP+281,TIP+283)
(*
(*            DEFINE REGION 147
(*
REG3D(147,STIP+633,STIP+635,STIP+636,STIP+637,STIP+638,SBLD+526, &
        LBLD+581,LBLD+582,LBLD+586,LBLD+583,LTIP+691,LTIP+693, &
        LTIP+695,LTIP+694,LTIP+690,LTIP+696,LTIP+697,LTIP+692, &
        BLAD+241,BLAD+242,BLAD+243,BLAD+244,TIP+283,TIP+284, &
        TIP+285,TIP+286)
(*
(*   GIVE THE USER THE OPTION TO FILL IN COOLING PASSAGE # 1
(*
(*
PRINT DO YOU WANT COOLING PASSGE # 1 FILLED IN ?
PRINT (1 = YES  -  2 = NO)
READ QUES1
IF (QUES1 = 1)
THEN
RULEDSRF (651,LBLD+376,LBLD+377)
RULEDSRF (652,PLAT+214,PLAT+219)
RULEDSRF (655,LBLD+484,LBLD+485)
(*
REG3D (150,SBLD+338,SBLD+372,SBLD+388,SBLD+335,652,651, &
        PLAT+214,PLAT+811,PLAT+219,PLAT+810,LBLD+376,LBLD+391, &
        LBLD+377,LBLD+370,LBLD+375,LBLD+378,LBLD+372,LBLD+371, &
        PLAT+103,PLAT+104,PLAT+105,PLAT+106,BLAD+163,BLAD+164, &
        BLAD+166,BLAD+167)
(*
REG3D (151,SBLD+437,SBLD+471,SBLD+487,SBLD+431,651,655, &
        LBLD+376,LBLD+391,LBLD+377,LBLD+370,LBLD+484,LBLD+490, &
        LBLD+485,LBLD+481,LBLD+480,LBLD+489,LBLD+491,LBLD+482, &
        BLAD+163,BLAD+164,BLAD+166,BLAD+167,BLAD+205,BLAD+206, &
        BLAD+208,BLAD+209)
ENDIF
(*
(*
(*
PRINT DO YOU WANT COOLING PASSGE # 5 FILLED IN ?
PRINT (1 = YES  -  2 = NO)
READ QUES2
IF (QUES2 = 1)
```

```
 THEN
 RULEDSRF (653,PLAT+339,PLAT+340)
 RULEDSRF (654,LBLD+462,LBLD+463)
 RULEDSRF (656,LBLD+571,LBLD+572)
(*
 REG3D (155,SBLD+370,SBLD+420,SBLD+416,SBLD+384,653,654, &
        PLAT+331,PLAT+339,PLAT+348,PLAT+340,LBLD+457,LBLD+462, &
        LBLD+815,LBLD+463,LBLD+456,LBLD+467,LBLD+468,LBLD+458, &
        PLAT+147,PLAT+148,PLAT+153,PLAT+154,BLAD+194,BLAD+195, &
        BLAD+198,BLAD+199)
(*
 REG3D (156,SBLD+469,SBLD+520,SBLD+516,SBLD+483,654,656, &
        LBLD+457,LBLD+462,LBLD+815,LBLD+463,LBLD+566,LBLD+571, &
        LBLD+576,LBLD+572,LBLD+818,LBLD+574,LBLD+575,LBLD+567, &
        BLAD+194,BLAD+195,BLAD+198,BLAD+199,BLAD+236,BLAD+237, &
        BLAD+239,BLAD+240)
 ENDIF
(*
(*             DEFINE REGION 160
(*
 REG3D(160,PLAT+124,PLAT+125,PLAT+121,PLAT+122,PLAT+123,PLAT+117,&
        PLAT+168,PLAT+169,PLAT+120,PLAT+165,PLAT+292,PLAT+299, &
        PLAT+282,PLAT+293,PLAT+281,PLAT+298,PLAT+283,PLAT+300, &
        PLAT+79 ,PLAT+20 ,PLAT+24 ,PLAT+81 ,PLAT+127,PLAT+128, &
        PLAT+133,PLAT+134)
(*
(*<><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*
(*             DISCRETIZE ALL REGIONS
(*
(*<><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
(*
 PRINT INPUT THE NUMBER OF NODES PER EDGE FOR THE DOVETAIL/SHANK
(* READ DNODE
 DNODE=2
(*
 DIS8NBRK (1)
 DISEDGE (DOVE+1,DNODE)
 DISEDGE (DOVE+3,DNODE)
 DISEDGE (DOVE+81,DNODE)
 ENDISCRT
(*
 DIS8NBRK (2)
 DISEDGE (DOVE+13,DNODE)
 DISEDGE (DOVE+11,DNODE)
 DISEDGE (DOVE+89,DNODE)
 ENDISCRT
(*
 DIS8NBRK (3)
 DISEDGE (DOVE+23,DNODE)
 DISEDGE (DOVE+21,DNODE)
 DISEDGE (DOVE+97,DNODE)
 ENDISCRT
```

```
(*
  DIS8NBRK (4)
  DISEDGE (DOVE+33.DNODE)
  DISEDGE (DOVE+31.DNODE)
  DISEDGE (DOVE+105.DNODE)
  ENDISCRT
(*
  DIS8NBRK (5)
  DISEDGE (DOVE+43.DNODE)
  DISEDGE (DOVE+41.DNODE)
  DISEDGE (DOVE+113.DNODE)
  ENDISCRT
(*
  DIS8NBRK (6)
  DISEDGE (DOVE+53.DNODE)
  DISEDGE (DOVE+51.DNODE)
  DISEDGE (DOVE+121.DNODE)
  ENDISCRT
(*
  DIS8NBRK (7)
  DISEDGE (DOVE+63.DNODE)
  DISEDGE (DOVE+61.DNODE)
  DISEDGE (DOVE+129.DNODE)
  ENDISCRT
(*
  DIS8NBRK (8)
  DISEDGE (DOVE+4, DNODE)
  DISEDGE (DOVE+9, DNODE)
  DISEDGE (DOVE+83. DNODE)
  ENDISCRT
(*
  DIS8NBRK (9)
  DISEDGE (DOVE+24.DNODE)
  DISEDGE (DOVE+29.DNODE)
  DISEDGE (DOVE+99. DNODE)
  ENDISCRT
(*
  DIS8NBRK (10)
  DISEDGE (DOVE+44.DNODE)
  DISEDGE (DOVE+49.DNODE)
  DISEDGE (DOVE+115.DNODE)
  ENDISCRT
(*
  DIS8NBRK (11)
  DISEDGE (DOVE+64.DNODE)
  DISEDGE (DOVE+69.DNODE)
  DISEDGE (DOVE+131.DNODE)
  ENDISCRT
(*
  DIS8NBRK (12)
  DISEDGE (DOVE+5, DNODE)
  DISEDGE (DOVE+10.DNODE)
  DISEDGE (DOVE+86, DNODE)
```

```
 ENDISCRT
(*
 DIS8NBRK (13)
 DISEDGE (DOVE+15,DNODE)
 DISEDGE (DOVE+20,DNODE)
 DISEDGE (DOVE+93, DNODE)
 ENDISCRT
(*
 DIS8NBRK (14)
 DISEDGE (DOVE+25,DNODE)
 DISEDGE (DOVE+30,DNODE)
 DISEDGE (DOVE+101,DNODE)
 ENDISCRT
(*
 DIS8NBRK (15)
 DISEDGE (DOVE+35,DNODE)
 DISEDGE (DOVE+40,DNODE)
 DISEDGE (DOVE+109,DNODE)
 ENDISCRT
(*
 DIS8NBRK (16)
 DISEDGE (DOVE+45,DNODE)
 DISEDGE (DOVE+50,DNODE)
 DISEDGE (DOVE+117,DNODE)
 ENDISCRT
(*
 DIS8NBRK (17)
 DISEDGE (DOVE+55,DNODE)
 DISEDGE (DOVE+60,DNODE)
 DISEDGE (DOVE+125,DNODE)
 ENDISCRT
(*
 DIS8NBRK (18)
 DISEDGE (DOVE+65,DNODE)
 DISEDGE (DOVE+70,DNODE)
 DISEDGE (DOVE+133,DNODE)
 ENDISCRT
(*
(*
 PRINT INPUT THE NUMBER OF NODES PER EDGE FOR THE PLATFORM
(* READ PNODE
 PNODE=2
(*
(*
 DIS8NBRK (19)
 DISEDGE (PLAT+200,PNODE)
 DISEDGE (PLAT+201,PNODE)
 DISEDGE (PLAT+202,PNODE)
 ENDISCRT
(*
 DIS8NBRK (20)
 DISEDGE (PLAT+208,PNODE)
 DISEDGE (PLAT+209,PNODE)
```

```
  DISEDGE (PLAT+210.PNODE)
  ENDISCRT
(*
  DIS8NBRK (21)
  DISEDGE (PLAT+226.PNODE)
  DISEDGE (PLAT+227.PNODE)
  DISEDGE (PLAT+235.PNODE)
  ENDISCRT
(*
  DIS8NBRK (22)
  DISEDGE (PLAT+241.PNODE)
  DISEDGE (PLAT+247.PNODE)
  DISEDGE (PLAT+249.PNODE)
  ENDISCRT
(*
  DIS8NBRK (23)
  DISEDGE (PLAT+258.PNODE)
  DISEDGE (PLAT+264.PNODE)
  DISEDGE (PLAT+265.PNODE)
  ENDISCRT
(*
  DIS8NBRK (24)
  DISEDGE (PLAT+275.PNODE)
  DISEDGE (PLAT+281.PNODE)
  DISEDGE (PLAT+282.PNODE)
  ENDISCRT
(*
  DIS8NBRK (25)
  DISEDGE (PLAT+168.PNODE)
  DISEDGE (PLAT+281.PNODE)
  DISEDGE (PLAT+165.PNODE)
  ENDISCRT
(*
  DIS8NBRK (26)
  DISEDGE (PLAT+309.PNODE)
  DISEDGE (PLAT+315.PNODE)
  DISEDGE (PLAT+316.PNODE)
  ENDISCRT
(*
  DIS8NBRK (27)
  DISEDGE (PLAT+804.PNODE)
  DISEDGE (PLAT+326.PNODE)
  DISEDGE (PLAT+327.PNODE)
  ENDISCRT
(*
  DIS8NBRK (28)
  DISEDGE (PLAT+337.PNODE)
  DISEDGE (PLAT+805.PNODE)
  DISEDGE (PLAT+343.PNODE)
  ENDISCRT
(*
  DIS8NBRK (29)
  DISEDGE (PLAT+212.PNODE)
```

```
  DISEDGE (PLAT+211.PNODE)
  DISEDGE (PLAT+800.PNODE)
  ENDISCRT
(*
  DIS8NBRK (30)
  DISEDGE (PLAT+236.PNODE)
  DISEDGE (PLAT+228.PNODE)
  DISEDGE (PLAT+801.PNODE)
  ENDISCRT
(*
  DIS8NBRK (31)
  DISEDGE (PLAT+242.PNODE)
  DISEDGE (PLAT+248.PNODE)
  DISEDGE (PLAT+250.PNODE)
  ENDISCRT
(*
  DIS8NBRK (32)
  DISEDGE (PLAT+259.PNODE)
  DISEDGE (PLAT+266.PNODE)
  DISEDGE (PLAT+267.PNODE)
  ENDISCRT
(*
  DIS8NBRK (33)
  DISEDGE (PLAT+276.PNODE)
  DISEDGE (PLAT+283.PNODE)
  DISEDGE (PLAT+284.PNODE)
  ENDISCRT
(*
  DIS8NBRK (34)
  DISEDGE (PLAT+293.PNODE)
  DISEDGE (PLAT+300.PNODE)
  DISEDGE (PLAT+301.PNODE)
  ENDISCRT
(*
  DIS8NBRK (35)
  DISEDGE (PLAT+310.PNODE)
  DISEDGE (PLAT+317.PNODE)
  DISEDGE (PLAT+318.PNODE)
  ENDISCRT
(*
  DIS8NBRK (36)
  DISEDGE (PLAT+806.PNODE)
  DISEDGE (PLAT+328.PNODE)
  DISEDGE (PLAT+329.PNODE)
  ENDISCRT
(*
  DIS8NBRK (37)
  DISEDGE (PLAT+338.PNODE)
  DISEDGE (PLAT+344.PNODE)
  DISEDGE (PLAT+345.PNODE)
  ENDISCRT
(*
  DIS8NBRK (38)
```

```
 DISEDGE (PLAT+203,PNODE)
 DISEDGE (PLAT+204,PNODE)
 DISEDGE (PLAT+215,PNODE)
 ENDISCRT
(*
 DIS8NBRK (39)
 DISEDGE (PLAT+214,PNODE)
 DISEDGE (PLAT+213,PNODE)
 DISEDGE (PLAT+811,PNODE)
 ENDISCRT
(*
 DIS8NBRK (40)
 DISEDGE (PLAT+237,PNODE)
 DISEDGE (PLAT+229,PNODE)
 DISEDGE (PLAT+230,PNODE)
 ENDISCRT
(*
 DIS8NBRK (41)
 DISEDGE (PLAT+260,PNODE)
 DISEDGE (PLAT+268,PNODE)
 DISEDGE (PLAT+269,PNODE)
 ENDISCRT
(*
 DIS8NBRK (42)
 DISEDGE (PLAT+294,PNODE)
 DISEDGE (PLAT+302,PNODE)
 DISEDGE (PLAT+303,PNODE)
 ENDISCRT
(*
 DIS8NBRK (43)
 DISEDGE (PLAT+807,PNODE)
 DISEDGE (PLAT+330,PNODE)
 DISEDGE (PLAT+331,PNODE)
 ENDISCRT
(*
 DIS8NBRK (44)
 DISEDGE (PLAT+331,PNODE)
 DISEDGE (PLAT+332,PNODE)
 DISEDGE (PLAT+339,PNODE)
 ENDISCRT
(*
 DIS8NBRK (45)
 DISEDGE (PLAT+348,PNODE)
 DISEDGE (PLAT+346,PNODE)
 DISEDGE (PLAT+345,PNODE)
 ENDISCRT
(*
 DIS8NBRK (46)
 DISEDGE (PLAT+219,PNODE)
 DISEDGE (PLAT+220,PNODE)
 DISEDGE (PLAT+802,PNODE)
 ENDISCRT
(*
```

```
DIS8NBRK (47)
DISEDGE (PLAT+238,PNODE)
DISEDGE (PLAT+231,PNODE)
DISEDGE (PLAT+803,PNODE)
ENDISCRT
(*
DIS8NBRK (48)
DISEDGE (PLAT+244,PNODE)
DISEDGE (PLAT+253,PNODE)
DISEDGE (PLAT+254,PNODE)
ENDISCRT
(*
DIS8NBRK (49)
DISEDGE (PLAT+261,PNODE)
DISEDGE (PLAT+270,PNODE)
DISEDGE (PLAT+271,PNODE)
ENDISCRT
(*
DIS8NBRK (50)
DISEDGE (PLAT+278,PNODE)
DISEDGE (PLAT+287,PNODE)
DISEDGE (PLAT+288,PNODE)
ENDISCRT
(*
DIS8NBRK (51)
DISEDGE (PLAT+295,PNODE)
DISEDGE (PLAT+304,PNODE)
DISEDGE (PLAT+305,PNODE)
ENDISCRT
(*
DIS8NBRK (52)
DISEDGE (PLAT+312,PNODE)
DISEDGE (PLAT+321,PNODE)
DISEDGE (PLAT+322,PNODE)
ENDISCRT
(*
DIS8NBRK (53)
DISEDGE (PLAT+808,PNODE)
DISEDGE (PLAT+332,PNODE)
DISEDGE (PLAT+333,PNODE)
ENDISCRT
(*
DIS8NBRK (54)
DISEDGE (PLAT+340,PNODE)
DISEDGE (PLAT+347,PNODE)
DISEDGE (PLAT+349,PNODE)
ENDISCRT
(*
DIS8NBRK (55)
DISEDGE (PLAT+351,PNODE)
DISEDGE (PLAT+344,PNODE)
DISEDGE (PLAT+354,PNODE)
ENDISCRT
```

```
(*
 DIS8NBRK (56)
 DISEDGE (PLAT+221,PNODE)
 DISEDGE (PLAT+223,PNODE)
 DISEDGE (PLAT+224,PNODE)
 ENDISCRT
(*
 DIS8NBRK (57)
 DISEDGE (PLAT+239,PNODE)
 DISEDGE (PLAT+232,PNODE)
 DISEDGE (PLAT+233,PNODE)
 ENDISCRT
(*
 DIS8NBRK (58)
 DISEDGE (PLAT+245,PNODE)
 DISEDGE (PLAT+255,PNODE)
 DISEDGE (PLAT+256,PNODE)
 ENDISCRT
(*
 DIS8NBRK (59)
 DISEDGE (PLAT+262,PNODE)
 DISEDGE (PLAT+272,PNODE)
 DISEDGE (PLAT+273,PNODE)
 ENDISCRT
(*
 DIS8NBRK (60)
 DISEDGE (PLAT+279,PNODE)
 DISEDGE (PLAT+289,PNODE)
 DISEDGE (PLAT+290,PNODE)
 ENDISCRT
(*
 DIS8NBRK (61)
 DISEDGE (PLAT+296,PNODE)
 DISEDGE (PLAT+306,PNODE)
 DISEDGE (PLAT+307,PNODE)
 ENDISCRT
(*
 DIS8NBRK (62)
 DISEDGE (PLAT+313,PNODE)
 DISEDGE (PLAT+323,PNODE)
 DISEDGE (PLAT+324,PNODE)
 ENDISCRT
(*
 DIS8NBRK (63)
 DISEDGE (PLAT+809,PNODE)
 DISEDGE (PLAT+334,PNODE)
 DISEDGE (PLAT+335,PNODE)
 ENDISCRT
(*
 DIS8NBRK (64)
 DISEDGE (PLAT+341,PNODE)
 DISEDGE (PLAT+350,PNODE)
 DISEDGE (PLAT+352,PNODE)
```

```
ENDISCRT
(*
DIS8NBRK (65)
DISEDGE (PLAT+356,PNODE)
DISEDGE (PLAT+358,PNODE)
DISEDGE (PLAT+361,PNODE)
ENDISCRT
(*
DIS8NBRK (66)
DISEDGE (PLAT+359,PNODE)
DISEDGE (PLAT+360,PNODE)
DISEDGE (PLAT+364,PNODE)
ENDISCRT
(*
DIS8NBRK (67)
DISEDGE (PLAT+343,PNODE)
DISEDGE (PLAT+805,PNODE)
DISEDGE (PLAT+354,PNODE)
ENDISCRT
(*
(*
PRINT INPUT THE NUMBER OF NODES PER EDGE FOR THE BLADE
(* READ BNODE
BNODE=2
(*
(*
DIS8NBRK (68)
DISEDGE (LBLD+365,BNODE)
DISEDGE (LBLD+368,BNODE)
DISEDGE (LBLD+366,BNODE)
ENDISCRT
(*
DIS8NBRK (69)
DISEDGE (LBLD+373,BNODE)
DISEDGE (LBLD+374,BNODE)
DISEDGE (LBLD+390,BNODE)
ENDISCRT
(*
DIS8NBRK (70)
DISEDGE (LBLD+381,BNODE)
DISEDGE (LBLD+385,BNODE)
DISEDGE (LBLD+393,BNODE)
ENDISCRT
(*
DIS8NBRK (71)
DISEDGE (LBLD+396,BNODE)
DISEDGE (LBLD+389,BNODE)
DISEDGE (LBLD+401,BNODE)
ENDISCRT
(*
DIS8NBRK (72)
DISEDGE (LBLD+406,BNODE)
DISEDGE (LBLD+410,BNODE)
```

```
 DISEDGE (LBLD+411,BNODE)
 ENDISCRT
(*
 DIS8NBRK (73)
 DISEDGE (LBLD+417,BNODE)
 DISEDGE (LBLD+421,BNODE)
 DISEDGE (LBLD+422,BNODE)
 ENDISCRT
(*
 DIS8NBRK (74)
 DISEDGE (LBLD+428,BNODE)
 DISEDGE (LBLD+432,BNODE)
 DISEDGE (LBLD+433,BNODE)
 ENDISCRT
(*
 DIS8NBRK (75)
 DISEDGE (LBLD+439,BNODE)
 DISEDGE (LBLD+443,BNODE)
 DISEDGE (LBLD+444,BNODE)
 ENDISCRT
(*
 DIS8NBRK (76)
 DISEDGE (LBLD+450,BNODE)
 DISEDGE (LBLD+454,BNODE)
 DISEDGE (LBLD+455,BNODE)
 ENDISCRT
(*
 DIS8NBRK (77)
 DISEDGE (LBLD+461,BNODE)
 DISEDGE (LBLD+465,BNODE)
 DISEDGE (LBLD+466,BNODE)
 ENDISCRT
(*
 DIS8NBRK (78)
 DISEDGE (LBLD+382,BNODE)
 DISEDGE (LBLD+386,BNODE)
 DISEDGE (LBLD+391,BNODE)
 ENDISCRT
(*
 DIS8NBRK (79)
 DISEDGE (LBLD+407,BNODE)
 DISEDGE (LBLD+412,BNODE)
 DISEDGE (LBLD+413,BNODE)
 ENDISCRT
(*
 DIS8NBRK (80)
 DISEDGE (LBLD+429,BNODE)
 DISEDGE (LBLD+434,BNODE)
 DISEDGE (LBLD+435,BNODE)
 ENDISCRT
(*
 DIS8NBRK (81)
 DISEDGE (LBLD+451,BNODE)
```

```
  DISEDGE (LBLD+456.BNODE)
  DISEDGE (LBLD+457.BNODE)
  ENDISCRT
(*
  DIS8NBRK (82)
  DISEDGE (LBLD+377.BNODE)
  DISEDGE (LBLD+378.BNODE)
  DISEDGE (LBLD+392.BNODE)
  ENDISCRT
(*
  DIS8NBRK (83)
  DISEDGE (LBLD+383.BNODE)
  DISEDGE (LBLD+387.BNODE)
  DISEDGE (LBLD+395.BNODE)
  ENDISCRT
(*
  DIS8NBRK (84)
  DISEDGE (LBLD+398.BNODE)
  DISEDGE (LBLD+403.BNODE)
  DISEDGE (LBLD+404.BNODE)
  ENDISCRT
(*
  DIS8NBRK (85)
  DISEDGE (LBLD+408.BNODE)
  DISEDGE (LBLD+414.BNODE)
  DISEDGE (LBLD+415.BNODE)
  ENDISCRT
(*
  DIS8NBRK (86)
  DISEDGE (LBLD+419.BNODE)
  DISEDGE (LBLD+425.BNODE)
  DISEDGE (LBLD+426.BNODE)
  ENDISCRT
(*
  DIS8NBRK (87)
  DISEDGE (LBLD+430.BNODE)
  DISEDGE (LBLD+436.BNODE)
  DISEDGE (LBLD+437.BNODE)
  ENDISCRT
(*
  DIS8NBRK (88)
  DISEDGE (LBLD+441.BNODE)
  DISEDGE (LBLD+447.BNODE)
  DISEDGE (LBLD+448.BNODE)
  ENDISCRT
(*
  DIS8NBRK (89)
  DISEDGE (LBLD+452.BNODE)
  DISEDGE (LBLD+458.BNODE)
  DISEDGE (LBLD+459.BNODE)
  ENDISCRT
(*
  DIS8NBRK (90)
```

```
DISEDGE (LBLD+463.BNODE)
DISEDGE (LBLD+468.BNODE)
DISEDGE (LBLD+469.BNODE)
ENDISCRT
(*
DIS8NBRK (91)
DISEDGE (LBLD+815.BNODE)
DISEDGE (LBLD+469.BNODE)
DISEDGE (LBLD+470.BNODE)
ENDISCRT
(*
DIS8NBRK (92)
DISEDGE (LBLD+472.BNODE)
DISEDGE (LBLD+471.BNODE)
DISEDGE (LBLD+465.BNODE)
ENDISCRT
(*
DIS8NBRK (93)
DISEDGE (LBLD+478.BNODE)
DISEDGE (LBLD+816.BNODE)
DISEDGE (LBLD+477.BNODE)
ENDISCRT
(*
DIS8NBRK (94)
DISEDGE (LBLD+483.BNODE)
DISEDGE (LBLD+487.BNODE)
DISEDGE (LBLD+488.BNODE)
ENDISCRT
(*
DIS8NBRK (95)
DISEDGE (LBLD+494.BNODE)
DISEDGE (LBLD+498.BNODE)
DISEDGE (LBLD+499.BNODE)
ENDISCRT
(*
DIS8NBRK (96)
DISEDGE (LBLD+505.BNODE)
DISEDGE (LBLD+509.BNODE)
DISEDGE (LBLD+510.BNODE)
ENDISCRT
(*
DIS8NBRK (97)
DISEDGE (LBLD+516.BNODE)
DISEDGE (LBLD+520.BNODE)
DISEDGE (LBLD+521.BNODE)
ENDISCRT
(*
DIS8NBRK (98)
DISEDGE (LBLD+527.BNODE)
DISEDGE (LBLD+531.BNODE)
DISEDGE (LBLD+532.BNODE)
ENDISCRT
(*
```

```
  DIS8NBRK (99)
  DISEDGE (LBLD+538.BNODE)
  DISEDGE (LBLD+542.BNODE)
  DISEDGE (LBLD+543.BNODE)
  ENDISCRT
(*
  DIS8NBRK (100)
  DISEDGE (LBLD+549.BNODE)
  DISEDGE (LBLD+553.BNODE)
  DISEDGE (LBLD+554.BNODE)
  ENDISCRT
(*
  DIS8NBRK (101)
  DISEDGE (LBLD+560.BNODE)
  DISEDGE (LBLD+564.BNODE)
  DISEDGE (LBLD+565.BNODE)
  ENDISCRT
(*
  DIS8NBRK (102)
  DISEDGE (LBLD+570.BNODE)
  DISEDGE (LBLD+579.BNODE)
  DISEDGE (LBLD+577.BNODE)
  ENDISCRT
(*
  DIS8NBRK (103)
  DISEDGE (LBLD+490.BNODE)
  DISEDGE (LBLD+495.BNODE)
  DISEDGE (LBLD+500.BNODE)
  ENDISCRT
(*
  DIS8NBRK (104)
  DISEDGE (LBLD+512.BNODE)
  DISEDGE (LBLD+517.BNODE)
  DISEDGE (LBLD+522.BNODE)
  ENDISCRT
(*
  DIS8NBRK (105)
  DISEDGE (LBLD+534.BNODE)
  DISEDGE (LBLD+539.BNODE)
  DISEDGE (LBLD+544.BNODE)
  ENDISCRT
(*
  DIS8NBRK (106)
  DISEDGE (LBLD+556.BNODE)
  DISEDGE (LBLD+561.BNODE)
  DISEDGE (LBLD+555.BNODE)
  ENDISCRT
(*
  DIS8NBRK (107)
  DISEDGE (LBLD+485.BNODE)
  DISEDGE (LBLD+491.BNODE)
  DISEDGE (LBLD+492.BNODE)
  ENDISCRT
```

```
(*
  DIS8NBRK (108)
  DISEDGE (LBLD+496.BNODE)
  DISEDGE (LBLD+502.BNODE)
  DISEDGE (LBLD+503.BNODE)
  ENDISCRT
(*
  DIS8NBRK (109)
  DISEDGE (LBLD+507.BNODE)
  DISEDGE (LBLD+513.BNODE)
  DISEDGE (LBLD+514.BNODE)
  ENDISCRT
(*
  DIS8NBRK (110)
  DISEDGE (LBLD+518.BNODE)
  DISEDGE (LBLD+524.BNODE)
  DISEDGE (LBLD+525.BNODE)
  ENDISCRT
(*
  DIS8NBRK (111)
  DISEDGE (LBLD+529.BNODE)
  DISEDGE (LBLD+535.BNODE)
  DISEDGE (LBLD+536.BNODE)
  ENDISCRT
(*
  DIS8NBRK (112)
  DISEDGE (LBLD+540.BNODE)
  DISEDGE (LBLD+546.BNODE)
  DISEDGE (LBLD+547.BNODE)
  ENDISCRT
(*
  DIS8NBRK (113)
  DISEDGE (LBLD+551.BNODE)
  DISEDGE (LBLD+557.BNODE)
  DISEDGE (LBLD+558.BNODE)
  ENDISCRT
(*
  DIS8NBRK (114)
  DISEDGE (LBLD+562.BNODE)
  DISEDGE (LBLD+567.BNODE)
  DISEDGE (LBLD+568.BNODE)
  ENDISCRT
(*
  DIS8NBRK (115)
  DISEDGE (LBLD+572.BNODE)
  DISEDGE (LBLD+575.BNODE)
  DISEDGE (LBLD+578.BNODE)
  ENDISCRT
(*
  DIS8NBRK (116)
  DISEDGE (LBLD+576.BNODE)
  DISEDGE (LBLD+578.BNODE)
  DISEDGE (LBLD+580.BNODE)
```

```
  ENDISCRT
(*
  DIS8NBRK (117)
  DISEDGE (LBLD+581,BNODE)
  DISEDGE (LBLD+582,BNODE)
  DISEDGE (LBLD+584,BNODE)
  ENDISCRT
(*
(*
  PRINT INPUT THE NUMBER OF NODES PER EDGE FOR THE TIP CAP
(* READ TNODE
  TNODE=2
(*
(*
  DIS8NBRK (118)
  DISEDGE (LTIP+589,TNODE)
  DISEDGE (LTIP+820,TNODE)
  DISEDGE (LTIP+587,TNODE)
  ENDISCRT
(*
  DIS8NBRK (119)
  DISEDGE (LTIP+593,TNODE)
  DISEDGE (LTIP+597,TNODE)
  DISEDGE (LTIP+598,TNODE)
  ENDISCRT
(*
  DIS8NBRK (120)
  DISEDGE (LTIP+604,TNODE)
  DISEDGE (LTIP+608,TNODE)
  DISEDGE (LTIP+609,TNODE)
  ENDISCRT
(*
  DIS8NBRK (121)
  DISEDGE (LTIP+615,TNODE)
  DISEDGE (LTIP+619,TNODE)
  DISEDGE (LTIP+620,TNODE)
  ENDISCRT
(*
  DIS8NBRK (122)
  DISEDGE (LTIP+626,TNODE)
  DISEDGE (LTIP+630,TNODE)
  DISEDGE (LTIP+631,TNODE)
  ENDISCRT
(*
  DIS8NBRK (123)
  DISEDGE (LTIP+637,TNODE)
  DISEDGE (LTIP+641,TNODE)
  DISEDGE (LTIP+642,TNODE)
  ENDISCRT
(*
  DIS8NBRK (124)
  DISEDGE (LTIP+648,TNODE)
  DISEDGE (LTIP+652,TNODE)
```

```
 DISEDGE (LTIP+653.TNODE)
 ENDISCRT
(*
 DIS8NBRK (125)
 DISEDGE (LTIP+659.TNODE)
 DISEDGE (LTIP+663.TNODE)
 DISEDGE (LTIP+664.TNODE)
 ENDISCRT
(*
 DIS8NBRK (126)
 DISEDGE (LTIP+670.TNODE)
 DISEDGE (LTIP+674.TNODE)
 DISEDGE (LTIP+675.TNODE)
 ENDISCRT
(*
 DIS8NBRK (127)
 DISEDGE (LTIP+681.TNODE)
 DISEDGE (LTIP+690.TNODE)
 DISEDGE (LTIP+687.TNODE)
 ENDISCRT
(*
 DIS8NBRK (128)
 DISEDGE (LTIP+594.TNODE)
 DISEDGE (LTIP+599.TNODE)
 DISEDGE (LTIP+600.TNODE)
 ENDISCRT
(*
 DIS8NBRK (129)
 DISEDGE (LTIP+605.TNODE)
 DISEDGE (LTIP+610.TNODE)
 DISEDGE (LTIP+611.TNODE)
 ENDISCRT
(*
 DIS8NBRK (130)
 DISEDGE (LTIP+616.TNODE)
 DISEDGE (LTIP+621.TNODE)
 DISEDGE (LTIP+622.TNODE)
 ENDISCRT
(*
 DIS8NBRK (131)
 DISEDGE (LTIP+627.TNODE)
 DISEDGE (LTIP+632.TNODE)
 DISEDGE (LTIP+633.TNODE)
 ENDISCRT
(*
 DIS8NBRK (132)
 DISEDGE (LTIP+638.TNODE)
 DISEDGE (LTIP+643.TNODE)
 DISEDGE (LTIP+644.TNODE)
 ENDISCRT
(*
 DIS8NBRK (133)
 DISEDGE (LTIP+649.TNODE)
```

```
  DISEDGE (LTIP+654.TNODE)
  DISEDGE (LTIP+655.TNODE)
  ENDISCRT
(*
  DIS8NBRK (134)
  DISEDGE (LTIP+660.TNODE)
  DISEDGE (LTIP+665.TNODE)
  DISEDGE (LTIP+666.TNODE)
  ENDISCRT
(*
  DIS8NBRK (135)
  DISEDGE (LTIP+671.TNODE)
  DISEDGE (LTIP+676.TNODE)
  DISEDGE (LTIP+677.TNODE)
  ENDISCRT
(*
  DIS8NBRK (136)
  DISEDGE (LTIP+682.TNODE)
  DISEDGE (LTIP+685.TNODE)
  DISEDGE (LTIP+689.TNODE)
  ENDISCRT
(*
  DIS8NBRK (137)
  DISEDGE (LTIP+819.TNODE)
  DISEDGE (LTIP+595.TNODE)
  DISEDGE (LTIP+601.TNODE)
  ENDISCRT
(*
  DIS8NBRK (138)
  DISEDGE (LTIP+606.TNODE)
  DISEDGE (LTIP+612.TNODE)
  DISEDGE (LTIP+613.TNODE)
  ENDISCRT
(*
  DIS8NBRK (139)
  DISEDGE (LTIP+617.TNODE)
  DISEDGE (LTIP+623.TNODE)
  DISEDGE (LTIP+624.TNODE)
  ENDISCRT
(*
  DIS8NBRK (140)
  DISEDGE (LTIP+628.TNODE)
  DISEDGE (LTIP+634.TNODE)
  DISEDGE (LTIP+635.TNODE)
  ENDISCRT
(*
  DIS8NBRK (141)
  DISEDGE (LTIP+639.TNODE)
  DISEDGE (LTIP+645.TNODE)
  DISEDGE (LTIP+646.TNODE)
  ENDISCRT
(*
  DIS8NBRK (142)
```

```
DISEDGE (LTIP+650,TNODE)
DISEDGE (LTIP+656,TNODE)
DISEDGE (LTIP+657,TNODE)
ENDISCRT
(*
DIS8NBRK (143)
DISEDGE (LTIP+661,TNODE)
DISEDGE (LTIP+667,TNODE)
DISEDGE (LTIP+668,TNODE)
ENDISCRT
(*
DIS8NBRK (144)
DISEDGE (LTIP+672,TNODE)
DISEDGE (LTIP+678,TNODE)
DISEDGE (LTIP+679,TNODE)
ENDISCRT
(*
DIS8NBRK (145)
DISEDGE (LTIP+683,TNODE)
DISEDGE (LTIP+686,TNODE)
DISEDGE (LTIP+688,TNODE)
ENDISCRT
(*
DIS8NBRK (146)
DISEDGE (LTIP+689,TNODE)
DISEDGE (LTIP+687,TNODE)
DISEDGE (LTIP+690,TNODE)
ENDISCRT
(*
DIS8NBRK (147)
DISEDGE (LTIP+691,TNODE)
DISEDGE (LTIP+693,TNODE)
DISEDGE (LTIP+690,TNODE)
ENDISCRT
(*
DIS8NBRK (160)
DISEDGE (PLAT+168,PNODE)
DISEDGE (PLAT+169,PNODE)
DISEDGE (PLAT+120,PNODE)
DISEDGE (PLAT+165,PNODE)
DISEDGE (PLAT+292,PNODE)
DISEDGE (PLAT+299,PNODE)
DISEDGE (PLAT+282,PNODE)
DISEDGE (PLAT+293,PNODE)
DISEDGE (PLAT+281,PNODE)
DISEDGE (PLAT+298,PNODE)
DISEDGE (PLAT+283,PNODE)
DISEDGE (PLAT+300,PNODE)
ENDISCRT
(*
IF (QUES1 = 1)
THEN
DIS8NBRK (150)
```

```
  DISEDGE (LBLD-376.BNODE)
  ENDISCRT
(*
  DIS8NBRK (151)
  DISEDGE (LBLD+376.BNODE)
  ENDISCRT
(*
  ENDIF
(*
(*
  IF (QUES2 = 1)
  THEN
  DIS8NBRK (155)
  DISEDGE (LBLD+462.BNODE)
  ENDISCRT
(*
  DIS8NBRK (156)
  DISEDGE (LBLD+462.BNODE)
  ENDISCRT
(*
  ENDIF
(*
(*
  END RECIPE
```

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13. ABSTRACT (Maximum 200 words)

ESMOSS is a specialized software system for the construction of geometric descriptive and discrete analytical models of engine parts, components and substructures which can be transferred to finite element analysis programs such as NASTRAN. The software architecture of ESMOSS is designed in modular form with a central executive module through which the user controls and directs the development of the analytical model. Modules consist of a geometric shape generator, a library of discretization procedures, interfacing modules to join both geometric and discrete models, a deck generator to produce input for NASTRAN and a "recipe" processor which generates geometric models from parametric definitions. ESMOSS can be executed both in interactive and batch modes. Interactive mode is considered to be the default mode and that mode will be assumed in the discussion in this document unless stated otherwise.

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