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Engine Structures Analysis Software: Component Specific Modeling (COSMO)

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1.0 Introduction

1.1 Task Objectives

The objective of this contract is to enhance Component Specific Modeling (COSMO) software to include geometry recipes for inlets, nozzles, shafts, frames, disks, and ducts. For these components, the software predicts temperature, deformation, stress, and strain histories throughout a complete flight mission.

1.2 Management Plan

The technical effort for this contract is being performed in the Product Definition and Analysis Methodologies area of the Chief Engineer's Office. The Principal Investigator, charged with the responsibility for ensuring that the technical efforts are completed on schedule, is Dr. Richard McKnight with Mr. Robert Maffeo and Mr. Stephen Schrantz as the major contributors. The LET Program Manager has responsibility for ensuring that the financial and reporting requirements are met.

1.3 Technical Plan Overview

The objectives of the technical effort in this contract are 1) to develop geometry recipes for nozzles, inlets, disks, frames, shafts, and ducts in both finite element and nurb form, 2) develop component design tools for nozzles, inlets, disks, frames, shafts, and ducts which utilize these recipes, and 3) develop an integrated design tool which combines the simulations of the nozzles, inlets, disks, frames, shafts, and ducts with the previously developed combustor, turbine blade, and turbine vane models for a total engine representation. These developments will be accomplished in cooperation and in conjuction with the developments in T/BEST, NPSS, and NICE. These efforts have been broken down into subtasks A through F, with F covering reporting and deliverables.

1.3.2 Sub Task B Disk, Frame, Duct, and Shaft Recipes

Recipes have been developed for disks in conjunction with those being studied for the High Speed Civil Transport Engine and the Advanced Subsonic Transport Engine. This expert program is capable of formulating the component geometry as finite element meshes for structural analysis and, in the future, can be spun off as NURB geometry for manufacturing. These recipes work through neutral files with the T/BEST program which provides them with the necessary base parameters and loadings. Appendix A is the COSMO User's Manual with the additions for the Disk Recipes. The disk recipe program was incorporated into COSMO by 7-1-94 and has been installed on the NASA-Lewis computer. This program uses a simple geometric disk recipe and generates an IGES geometry file, a 2D finite element mesh, a 3D finite element mesh, a PATRAN Neutral File, and a CSTEM input file. Future versions will include a direct interface to the T/BEST Neutral File and an option to run a disk analysis tool.

COSMO USER'S MANUAL

1. COSMO SYSTEM

1.1. Introduction

The Component Specific Structural Modeling (COSMO) System is a product of the GE Aircraft Engines' Product Definition and Analysis Methodologies Sub-Section and is intended to consolidate and streamline a number of the functions involved in structural analysis of aircraft engine components for NASA. This manual is for Version I.01 of COSMO which was released in the second quarter of 1994. This version of COSMO is an expansion of the original COSMO software, documented in the final report for NAS3-23687 (Component-Specific Modeling).

1.2. Essential Definitions and Jargon

As with any computer program, there are a number of definitions and abbreviations which you need to understand in order to use COSMO or this manual. The following is a list of abbreviations, program names, etc. which you may encounter in using COSMO.

ANSYS	A general purpose finite element analysis program supplied by Swanson Analysis Systems.
ASCII	Abbreviation for American Standard Code for Information Interchange. This is a method of representing character data as a binary number. This format is used on most computer systems for storing plain, old listable files. Therefore, these are usually called "ASCII Files."
CSTEM	A finite element analysis program developed by GEAE under NASA contract. CSTEM was specifically developed for analyzing composite structures.
IGES	Abbreviation for International Graphics Exchange Specification, a file format for geometric data. This format is supported by many commercial drafting systems and computer programs.
NASTRAN	A general purpose finite element analysis program supplied by MacNeil Schwindler Co. (MSC).
Neutral File	An input format used to define component data and mission data for COSMO (T/BEST).
PATRAN	A general purpose finite element pre and post processing program supplied by PDA Engineering.
RDB	Abbreviation for Random Data Base. This is a random, system dependent file created from a UIF.
SIESTA	GEAE finite element pre and post processing program. Performs many supporting functions in COSMO for model generation.

T/BEST	NASA Technology Benefit Estimator.
UIF	Abbreviation for Unified Input File. This is an ASCII file used for defining input data in COSMO. The format of this file is described in Section 2 of the SIESTA manual.
UOF	Abbreviation for Unified Input File. This is an ASCII file used for defining output data in COSMO. The format of this file is described in Section 3 of the SIESTA manual.

1.3. Current Functions and Function Summaries

A summary of all functions currently available in COSMO, are listed in Section 1.4. A complete listing of the current menu is available at any time from COSMO using the MENU keyword. For more information on a specific function, you should consult the detailed descriptions in Section 1.6. The first page of each function description is a summary which may be useful in determining if a function is suitable for your particular need. The format of this summary with examples is shown below.

SAMPLE FUNCTION SUMMARY

FUNCTION:

This is the "name" of the function.
EXAMPLE: Create Random Data Base from Unified Input File

SUB-MENU LOCATION:

This is the Sub-Menu and Function number for this function.
EXAMPLE: Data Base (Sub-Menu 1, Function 1 or UIFREAD)

PURPOSE:

This is a short description of the capabilities and use of this function.
EXAMPLE: This function reads a Unified Input File (UIF), checks the syntax and writes a Random Data Base (RDB).

INPUT FILES:

This is a list of any required or optional input files, as well as the default file code.
EXAMPLE: UIF (31)

OUTPUT FILES:

This is a list of any output files produced by the function along with the file code.
EXAMPLE: RDB (37)

REQUIRED USER INPUT:

This is a brief summary of required interactive input.
EXAMPLE: None, unless terminal input is requested in the UIF.

COMMENTS:

This is usually a list of limitations or informational items.
EXAMPLE: The default values of maximum node and element name are 20000.

FUNCTION VERSION INFORMATION:

This tells you the version of the function to which the documentation applies. New versions (indicated by a higher number) may contain additional features requiring updated documentation. In this case, an updated version of the documentation for a specific function may be obtained from COSMO support.
EXAMPLE: Any changes made to this function after version I.00 01-93 will not be reflected in this release of the manual.

1.4. Current Menu Structure

The following is a list of the entire COSMO menu structure showing Sub-Menu and Function numbers as well as the single-word commands (NNNN) to execute each function.

<u>COSMO GEOMETRY (SUB-MENU 1)</u>

1) COMBUSTOR LINER MODEL GENERATOR (**CLINER**)
Reads a T/BEST Neutral FIle and generates a 3D Combustor Liner model.

2) COMPONENT SPECIFIC AIRFOIL GENERATOR (**AGEN**)
Generates a user defined airfoil mesh from a geometric input file.

3) DISK MODEL GENERATOR (**DISK**)
Generates a 2D and 3D disk model.

4) PRINT MENU STRUCTURE (**MENU**)
Prints a copy of the current COSMO menu structure.

5) COSMO NEWS (**NEWS**)
Prints news items about COSMO. Also prints phone list of COSMO personnel.

<u>SIESTA FUNCTIONS (SUB-MENU 2)</u>

1) CREATE SIESTA RDB FROM A UIF (**UIFREAD**)
Reads a UIF and writes a SIESTA RDB.

2) RDB OUTLINE GENERATOR (**OUTLINE**)
Determines the perimeter of discretized 2D regions and stores this information on a RDB. This information can be used by other functions.

3) RDB SURFACE GENERATOR (**SURFACE**)
Determines the free surfaces, free edges and "boundary surfaces" of solid elements on a RDB. This information can be used to generate hidden-line and free-surface plots using the SIESTA Graphics function or to apply boundary conditions.

4) EDIT RANDOM DATA BASE (**EDIT**)
Edits a RDB by adding data or overwriting existing data.

5) CREATE NASTRAN BULK DATA DECK (**NASTRAN**)
Generates an NASTRAN bulk data deck from a RDB.

6) SIESTA GRAPHICS (**GRAPHICS**)
Generates plots from a RDB. Extensive label and plot options are available including hidden line and free surface or edge plots. This function will also produce deformed

shape plots and contour plots of data from a Unified Output File. Also generates hard copies of plots (Hardcopy devices are system dependent but include Postscript.)

7) SIESTA PLOTTING (**PLOT**)
Generates X-Y plots of data. Includes log plots, polar plots, multiple axes, and hardcopy capability.

8) CONVERT RDB TO UIF (**UIFWRITE**)
Writes a UIF from a RDB. All data may be "dumped" or selective values may be written. This function also permits renumbering of nodes and elements on the output UIF.

9) CONVERT PATRAN NEUTRAL FILE TO UIF (**UF4**)
Converts PATRAN Neutral file to a Unified Input File.

10) MASTER REGION MESH GENERATOR (MR.MESH) (**MESH**)
Creates a discretized 2D mesh from a master region definition. Either triangles or quadrilaterals may be created.

11) 2D TO 3D MODEL GENERATOR (**TO3D**)
Generates a UIF of 3D elements from a RDB containing 2D data. For example, a 2D quadrilateral model may be rotated or stacked to create a 3D 8-noded brick model.

12) BANDWIDTH REDUCTION (GIBBS-POOLE-STOCKMEYER) (**BAND**)
Performs bandwidth reduction on a finite element model using the Gibbs-Poole-Stockmeyer algorithm.

13) TRANSLATE RDB TO IGES GEOMETRY FILE (**GEOM**)
Writes out geometry data from a RDB in IGES format.

14) TRANSLATE RDB TO PATRAN NEUTRAL FILE (**PATRAN**)
Generates a PATRAN Neutral File from an RDB.

15) AIRFOIL MESH GENERATOR (**AIRFOIL**)
Creates a user defined mesh from a variety of airfoil geometry input files.

16) SIESTA CSTEM DECK GENERATOR (**CP4**)
Generates an input file for the CSTEM analysis program from an RDB.

CUSTOMIZE COSMO (SUB-MENU 31)

1) BUILD CUSTOM MENUS
Permits users to define their own customized menus for COSMO.

2) DISPLAY CUSTOM MENU TITLES
Displays titles of user defined custom menus.

3) WRITE CUSTOM MENU DEFINITION FILE
Writes file of custom menu data for use in a later COSMO session.

Sub-Menus 32-50 are reserved as user custom sub-menus. These sub-menus are created using Sub-Menu 31, Function 1 or can be created by the default custom sub-menu definition file (cosmo.m) located in your current directory or in your COSMO.D directory. The COSMO.D directory should be located under your main or home directory. Once a custom sub-menu is created, it can be used like any other COSMO sub-menu. A custom sub-menu can contain up to twenty functions. The sub-menu title can be up to thirty characters and the function descriptions can be up to fifty characters. A single "*" is used to indicate the end of a sub-menu. Specific system commands can be entered in the function description for the the system function using # as a prefix. Also comments can append the function description for system function using $. For the example custom menu, entering "34 1" at the sub-menu, function prompt would result in the list of files in the current directory being printed to the terminal. The function description is: # ls -x $ List Directory. ($ List Directory is the comment)

Custom sub-menu definition file format:

```
Sub-Menu 32 Title
Function 1
    Function 1 description
Function 2
    Function 2 description
      . . .
      . . .
Function n
    Function n description
*
Sub-Menu 33 Title
Function 1
    Function 1 description
Function 2
    Function 2 description
      . . .
      . . .
Function n
    Function n description
```

Example cosmo.m: (Description of Data)

PROCESS 1 (Sub-Menu 32 Title)
1 1 (Function 1 - CLINER)
_ (Function description - C/R for COSMO default description)
AGEN (Function 2 - Airfoil Generator)
WONDERFUL COSMO AIRFOIL PROGRAM (Description of AGEN)
* (End of Sub-Menu 32, Start of Sub-Menu 33)
USER SYSTEM COMMANDS (Sub-Menu 33 Title)
SYSTEM (Function 1)
ls -x $ List Directory (List Directory in UNIX)
SYSTEM (Function 2)

date   (Print current date and time in UNIX)

If the example cosmo.m file is read into COSMO, entering two separate commands ("32 0", and "33 0") results in the available functions for each custom sub-menu being printed to the terminal.

```
                    YOU ARE IN THE MAIN SUB-MENU (0)
        ENTER DESIRED FUNCTION BY NUMBER OR ?,G,Q,SYSTEM,CRUN
32 0
                PROCESS 1 SUB-MENU (32)

                 0 RETURN TO MAIN MENU (0)
CLINER           1 COMBUSTOR LINER MODEL GENERATOR
AGEN             2 WONDERFUL COSMO AIRFOIL PROGRAM

                YOU ARE IN THE PROCESS 1 SUB-MENU (32)
        ENTER DESIRED FUNCTION BY NUMBER OR ?,G,Q,SYSTEM
33 0
                USER SYSTEM COMMANDS SUB-MENU (34)

                 0 RETURN TO MAIN MENU (0)
                 1 # ls -x
                 2 # date

                YOU ARE IN THE USER SYSTEM COMMANDS SUB-MENU (34)
        ENTER DESIRED FUNCTION BY NUMBER OR ?,G,Q,SYSTEM,CRUN
```

This should give the user a good idea of how custom sub-menus work in COSMO.

If you choose to create the custom sub-menus interactively, use Sub-Menu 31, Function 1. When you run this function, you will be prompted for a custom sub-menu file or to enter a carriage return for manual input. The custom sub-menu file is the same format at the cosmo.m file.

```
ENTER THE COSMO CUSTOM SUB-MENU 32 FILE
OR ENTER A CARRIAGE RETURN FOR MANUAL COMMAND INPUT
```

If you enter carriage return for manual input, you will be prompted for the sub-menu title:

```
ENTER THE CUSTOM SUB-MENU 32 TITLE
(UP TO 30 CHARACTERS)
ENTER * TO START SUB-MENU 33
```

You should enter the desired sub-menu title. Then you will be prompted for the function command for the first function in the custom sub-menu:

```
ENTER THE COSMO FUNCTION COMMAND FOR
CUSTOM SUB-MENU 32 FUNCTION 1
(ENTER A CARRIAGE RETURN TO END INPUT)
ENTER * TO START SUB-MENU 33
```

You then enter the desired function keyword or sub-menu/function of the function. Then you will be prompted for the function description to appear in the custom sub-menu:

ENTER THE COSMO FUNCTION CUSTOM DESCRIPTION
(UP TO 50 CHARACTERS),
ENTER CARRIAGE RETURN TO USE COSMO DESCRIPTION

You should enter the desired function description for the custom sub-menu. If you enter carriage return, the default COSMO function description is used. If the function is "SYSTEM", then the desired system command can be entered using the # prefix. In this case, when you select this function, the system command specified in the description will be executed.

You will be prompted for function commands and descriptions until you enter "*" to start a new custom sub-menu or carriage return at the function command prompt to end custom sub-menu input. Users will probably find it easier to create a cosmo.m file external to COSMO. However, Sub-Menu 31 is provided to assist users in creating custom sub-menus.

If you wish to print out the list of custom sub-menus, use Sub-Menu 31, Function 2. For the example custom sub-menus, the list of custom sub-menus is:

AVAILABLE CUSTOM SUB-MENUS
32 PROCESS 1
33 USER SYSTEM COMMANDS

If you wish to write out the custom sub-menus created by Sub-Menu 31, Function 1, use Sub-Menu 31, Function 3. If you run this function, the current custom sub-menu definition data is written to file 58. The file 58 can be renamed to cosmo.m for future use.

1.5. How to Run COSMO

In order to access the COSMO system, enter "xcosmo".

You can set up COSMO UNIX scripts to run specific functions without manual input. The script file is a list of commands you would give COSMO during any COSMO session. There are two methods used for COSMO scripts. One uses input redirection to read a list of commands from a file. For example, to create an SIESTA RDB from a UIF, the input file is (file name is file1):

```
UIFR
uif
QUIT
```

To run COSMO and create the SIESTA RDB, you would enter "xcosmo p <file1". Note: the argument p indicated that you are running production COSMO. The other method includes the "xcosmo" command in the script. This script to create an SIESTA RDB is (file name is file2):

```
xcosmo p <<stop01
UIFR
uif
```

QUIT
stop01

To run this COSMO script, you would enter "file2". (Note: file permissions must be set to allow for file execution or enter "sh file2" to run this script). If you do not understand these script methods, look up scripts in a UNIX User's Manual or call your system administrator for help. Scripts can may your work much easier and more automated. We recommend that you use them wisely.

Initially, the system will print out an opening banner, any currently applicable messages, and a list of available sub-menus. To enter a sub-menu, enter the appropriate sub-menu number. Upon entering a sub-menu from the main menu, a list of available functions is printed. The desired function is then selected by number.

In order to save the experienced user time and effort, the sub-menu and function number may be entered at any point. For example, if you were in the COSMO Main menu and wished to go the COSMO Combustor Liner Generator (Sub-Menu 1, Function 1 or **CLINER**), you would enter "1,1" or "1 1". This would take you directly to that function, and upon completion you would be in Sub-Menu 1.

Several other inputs are possible at any point. A carriage return will move you back up a level in the menu structure. This will take you back to the main menu from a sub-menu. A "Q" means quit and will return you to system level directly from anywhere. A "?" will print out the available functions if you are in a sub-menu or the available sub-menus if you are in the main menu.

The command "SYSTEM" allows you to issue a system command from within COSMO. This permits you to check your catalog for a forgotten file name, or perform other system functions without exiting COSMO. After entering "SYSTEM", you are prompted for the operating system command. You will remain in SYSTEM mode until you enter "QUIT".

All COSMO functions can be run by entering single-word commands. These commands are included in the Complete menu list of Section 1.4. Only the first four characters of these commands are required.

When files are written by COSMO, files referred to by two digits such as "60" have the file name "f60.dat". If COSMO needs to create a file for output, it will not overwrite or delete an existing file without permission. If, for example, a file 45 is needed for output, and you have a file named f45.dat in your current directory, you will have the option of deleting the existing file, making it a permanent file, or stopping execution. Also when entering file names, you can enter .dir to list the current directory or .sys to run a system command. You will then be prompted to enter the file name again.

If you screw up while entering a file name (e.g. entering an incorrect name), COSMO will prompt you for the file again after determining that the specified file doesn't exist. If you can't remember the proper file name, enter "QUIT". This will terminate the current function and return you to the sub-menu level.

When you run COSMO geometric recipe functions, you are prompted for the part name. This part name is used to name output files in COSMO. A part name may be up to eight characters. If the part name is entered as partname, then the COSMO output files would be partname.ext. The file extension used is different for each file type. The COSMO file extensions are:

.par	COSMO Parameter File
.igs	IGES File
.guf	Geometry UIF
.2uf	2D Model UIF
.3uf	3D Model UIF
.tuf	Temperature and Pressure UIF
.suf	Shell UIF
.pnf	Patran Neutral File
.cst	CSTEM Input File

1.6. COSMO Function Summaries

The COSMO function summaries are on the following pages.

COSMO FUNCTION SUMMARY

FUNCTION:
Combustor Liner Model Generator

SUB-MENU LOCATION:
COSMO Geometry (Sub-Menu 1, Function 1 or **CLINER**)

PURPOSE:
This function generates a 3D combustor liner model using a set of parameters to define the combustor liner cross section. Certain parameters can be read from a T/BEST Neutral File. Combustor inlet and exit pressures and temperatures can be used to map pressures and temperatures onto the combustor liner model. The output is a Unified Input File (UIF). Optionally an IGES file, Patran Neutral File and/or a CSTEM input deck can be generated.

INPUT FILE(S):
T/BEST Neutral File (55)
Combustor Liner Parameter File (52)

OUTPUT FILE(S):
Combustor Liner Parameter File (partname.par)
2D IGES file (partname.igs)
2D Geometry UIF (partname.guf)
2D Combustor Liner UIF (partname.2uf)
3D Combustor Liner UIF (partname. 3uf)
3D Pressure and Temperature UIF (partname.tuf)
3D Patran Neutral File (partname.pnf)
3D CSTEM input file (partname.cst)

REQUIRED USER INPUT:
The part name used to name output files must be input. The combustor liner parameters, number of fuel nozzles, number of circumferential elements and element circumferential spacing must be specified.

COMMENTS:
NONE

FUNCTION VERSION INFORMATION:
Any changes made to this function after version <u>I.02 06-94</u> will not be reflected in this release of the manual.

1.6.1.1.1. INTRODUCTION

The combustor liner model generator generates a finite element mesh of a combustor liner using a set of specified parameters to define the combustor liner cross section. Certain parameters can be read from a T/BEST Neutral File. Combustor inlet and exit pressures and temperatures can be used to map pressures and temperatures onto the combustor liner model. The output is a Unified Input File (UIF). Optionally a 2D geometry UIF, a 2D IGES file, a Patran Neutral File and/or a CSTEM input deck can be generated. The mesh will consist of 20-nodel solid elements.

When you run this function, you are prompted for the part name. This part name is used to name output files in COSMO. A part name may be up to eight characters. If the part name is entered as <u>partname</u>, then the 3D UIF would be <u>partname.3uf</u>.

1.6.1.1.2. COMBUSTOR LINER PARAMETERS

The combustor liner cross section is defined by 23 parameters. Figure 1.6.1.1.1 shows the combustor liner cross section and parameters. The parameters can be input interactively or using an input file. Also certain parameters can be set by the T/BEST Neutral File (see section 1.6.1.1.3).

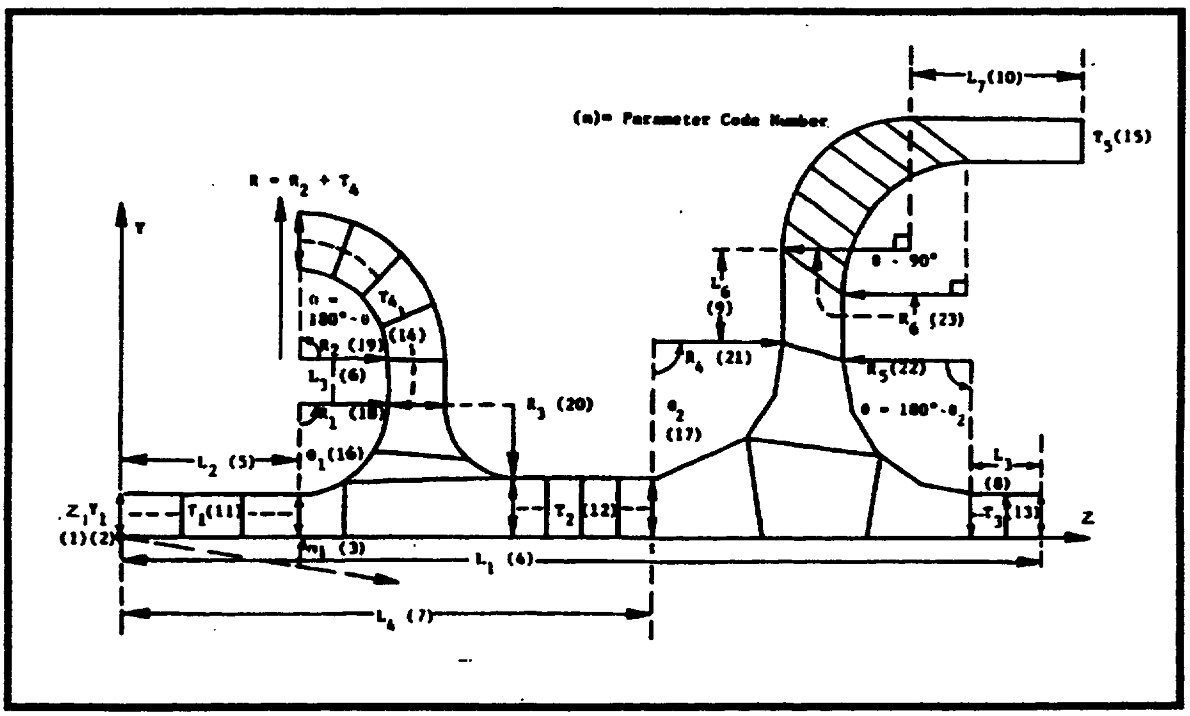


Figure 1.6.1.1.1
Combustor Liner Parameters

Z = Coordinate, Y = Coordinate, α = Rotation about Z, L = Length, T = Thickness, R = Radius of Curvature, θ = Angle of Rotation.

Combustor Liner Parameter List

Code	Name	Default	Code	Name	Default	Code	Name	Default
1	Z1	0.	2	Y1	10.	3	$\alpha 1$	0.
4	L1	10.5	5	L2	2.	6	L3	0.5
7	L4	6.	8	L5	0.8	9	L6	1.0
10	L7	2.	11	T1	0.5	12	T2	0.7
13	T3	0.5	14	T4	0.65	15	T5	0.5
16	$\theta 1$	90.	17	$\theta 2$	90.	18	R1	1.0
19	R2	1.	20	R3	0.75	21	R4	1.5
22	R5	1.5	23	R6	1.5			

There are also three control parameters:

24	IGES Write
25	Patran Neutral File Write
26	CSTEM Deck Write

The possible values for the control parameters are: -1 prompt user for the process, 0 skip the process, or 1 perform the process. The default values of these parameters is -1.

1.6.1.1.3. T/BEST NEUTRAL FILE

The T/BEST Neutral File is being used to define the engine component geometries and operating conditions using parameters. Data for the combustor is given for the component type: PBUR. Currently four geometric parameters and the inlet and exit pressures and temperatures can be read from the T/BEST Neutral File. The combustor liner inner radius (ROUT) is parameter 2, the combustor liner length (LENGTH) is parameter 4, and the combustor liner thickness (CTHK) is parameters 11, 12, 13, 14, and 15. Parameter 7 is calculated relative to parameter 4. The number of fuel nozzles is used to determine the model sector angle. This is discussed in section 1.6.1.1.4. Excerpts from the example T/BEST Neutral File is given in Table 1.6.1.1.1. The data that is read by this program is underlined. Note: this program can be updated to read additional data added to the T/BEST Neutral File.

```
*** TBEST EXECUTIVE SYSTEM - NEUTRAL FILE UPDATE ***
---------------------------------------------------
  .   .   .
  .   .   .
  .   .   .
ENGINE COMPONENT TYPE: PBUR   NCC          7
   MATERIAL                   CMPMAT     NICKEL
   PROCESS                    TYPROC     MAURER
   PBUR WEIGHT                WGHT        0.62710E+03   (lbs)
   STOCK MATERIAL WEIGHT      SWGHT       0.00000E+00   (lbs)
   MAURER WEIGHT FACTOR       MAURER      0.00000E+00   (lbs)
   COST TO MANUFACTURE ONE    COST1       0.00000E+00   ($)
   INNER RADIUS               RIN         0.19660E+02   (in.)
   OUTER RADIUS               ROUT        0.22750E+02   (in.)
   COMPONENT LENGTH           LENGTH      0.18000E+02   (in.)
   NUMBER OF NOZZLES          NCNOZZ          4.0
   COMBUSTOR THICKNESS        CTHK        0.10000E+00   (in.)
  .   .   .
  .   .   .
  .   .   .
```

```
GLOBAL VARIABLES 3 - MISSION
  ALTITUDE                     CALT        0.00000E+00   (ft.)
    SPEED                      V           0.00000E+00   (MACH No.)
  .    .    .
  .    .    .
  .    .    .
    COMPONENT TYPE: PBUR       NCC           7.0
    STATION NUMBER AT INLET    STIDIN        7.0
    PRESSURE AT INLET          PPBUR1      0.30870E+03   (psi.)
    TEMPERATURE AT INLET       TPBUR1      0.88948E+03   (F.)
    STATION NUMBER AT EXIT     STIDEX        8.0
    PRESSURE AT EXIT           PPBUR2      0.29018E+03   (psi.)
    TEMPERATURE AT EXIT        TPBUR2      0.26368E+04   (F)
  .    .    .
  .    .    .
  .    .    .
  ALTITUDE                     CALT        0.00000E+00   (ft.)
    SPEED                      V           0.00000E+00   (MACH No.)
  .    .    .
  .    .    .
  .    .    .
    COMPONENT TYPE: PBUR       NCC           7.0
    STATION NUMBER AT INLET    STIDIN        7.0
    PRESSURE AT INLET          PPBUR1      0.30352E+03   (psi.)
    TEMPERATURE AT INLET       TPBUR1      0.88194E+03   (F.)
    STATION NUMBER AT EXIT     STIDEX        8.0
    PRESSURE AT EXIT           PPBUR2      0.28531E+03   (psi.)
    TEMPERATURE AT EXIT        TPBUR2      0.25819E+04   (F)
  .    .    .
  .    .    .
  .    .    .
```

Table 1.6.1.1.1
T/BEST Neutral File

1.6.1.1.4. COMBUSTOR LINER MODEL GENERATION

Once the combustor liner parameters have been specified, the 2D cross section model is generated. You are prompted to enter 1 to write out the 2D IGES file. If you select this option, you will be asked for the part name, your name, and your organization. This data is written to the IGES file. The IGES file is written as partnam.igs. A separate 2D geometry UIF is written as partname.guf. Then the 2D model is rotated into a 3D sector model of the combustor liner. The 3D model is a symmetry model of half of one nozzle. The model is rotated about the Z axis. If the T/BEST Neutral File is not read, then you will be prompted for the number of nozzles and the number of elements circumferentially in the model. Then you will be prompted for the circumferential spacing. Enter a carriage return to use equal spacing. Enter circumferential percentages with the sum being less than 1.0. For example, for 4 circumferential elements, biasing percentages of 0.10 0.23 0.34 with place the nodal sections at 0, 10%, 33%, 67%, and 100% of the sector angle. The 3D combustor liner model is then generated.

If there is mission data in the T/BEST Neutral File, combustor inlet and exit pressures and temperatures are read from the file. A table of the mission data is written to the screen. The pressures are applied linearly along the inner surface of the combustor liner. There is no circumferential variation of pressure. The temperatures are also applied linearly to the nodes of the entire combustor liner. A circumferential temperature variation (varying with cos(θ)) can be superimposed on the linear temperature distribution. You will be prompted for the magnitude of the circumferential variation (DELT). This temperature variation is added to the linear temperatures.

1.6.1.1.5. OUTPUT

The output is a UIF (partname.3uf) of the combustor liner model. The model is a sector model with symmetry boundary conditions. Optionally a Patran Neutral File (partname.pnf) and/or a CSTEM input deck (partname.cst) can be written. If pressures and temperatures are read from the T/BEST Neutral File, the combustor liner pressures and pressures are written to a UIF (partname.tuf). You will be prompted for the case number of the mission data to use for the Patran Neutral File and/or the CSTEM input file. This allows pressures and temperatures to be written to these files.

1.6.1.1.6. EXAMPLE

Following is an example of running the Combustor Liner Model Generator. Note: this example uses the T/BEST Neutral File as input. See Figures 1.6.1.1.2 - 1.6.1.1.5 for plots of the combustor liner model generated.

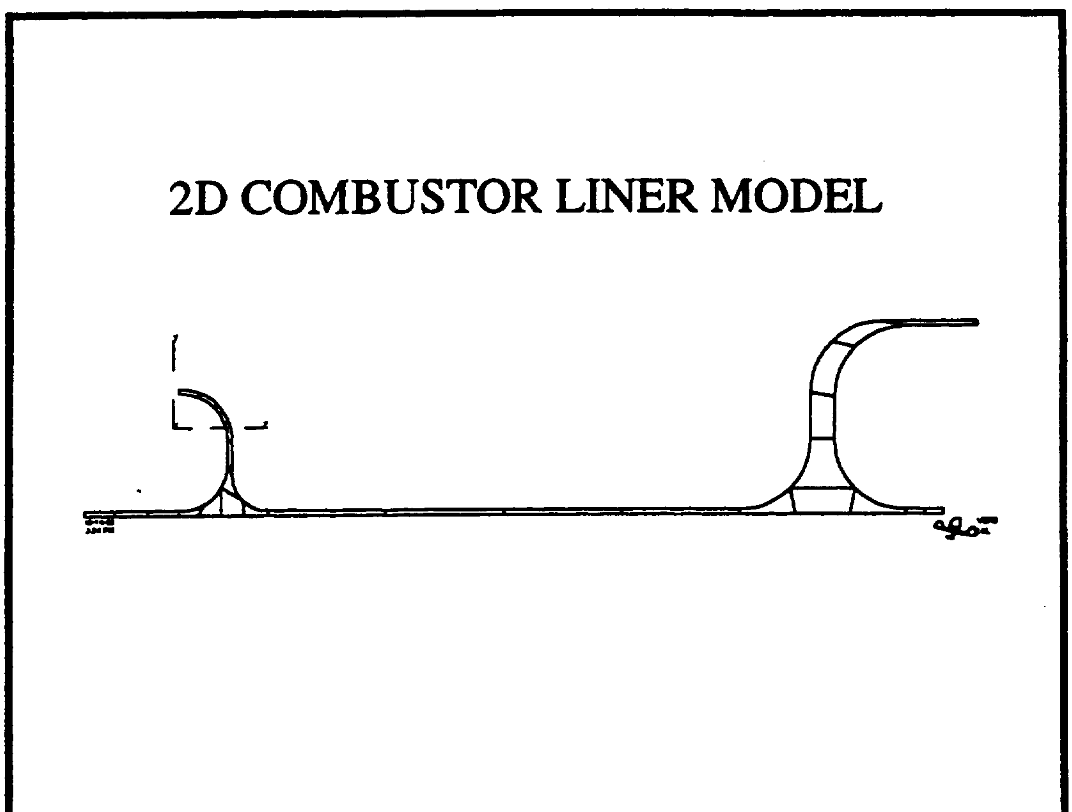


Figure 1.6.1.1.2

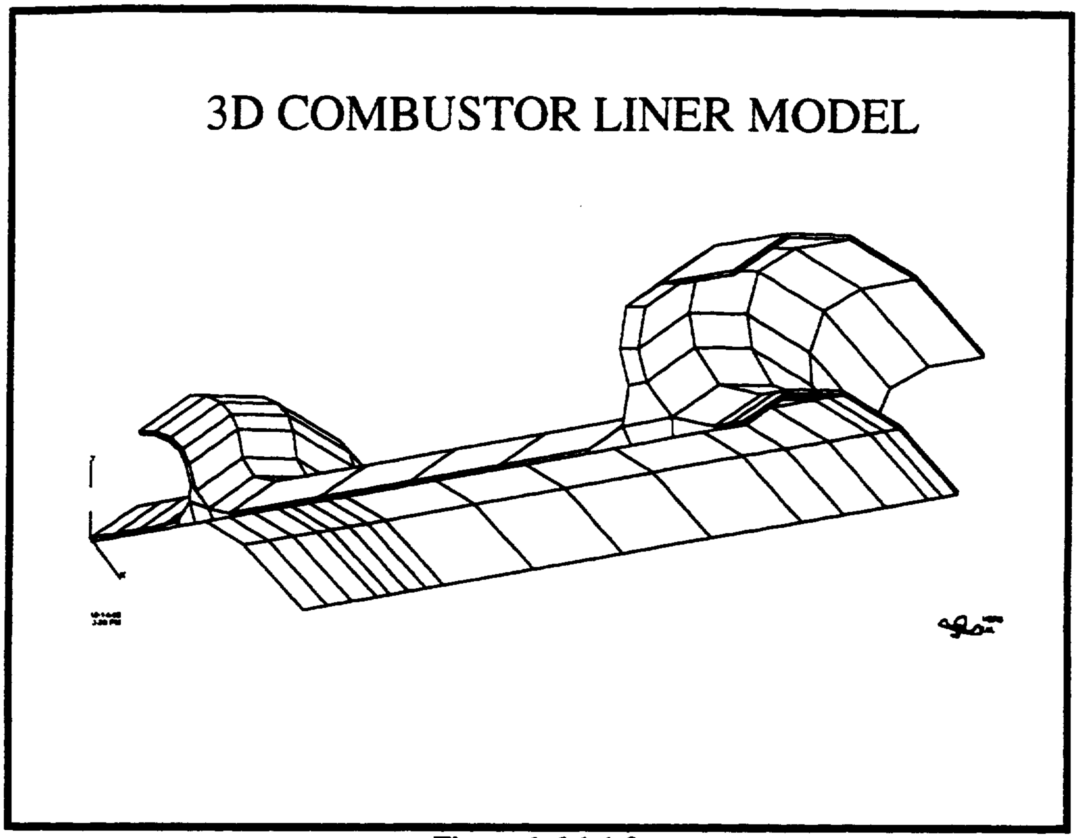


Figure 1.6.1.1.3

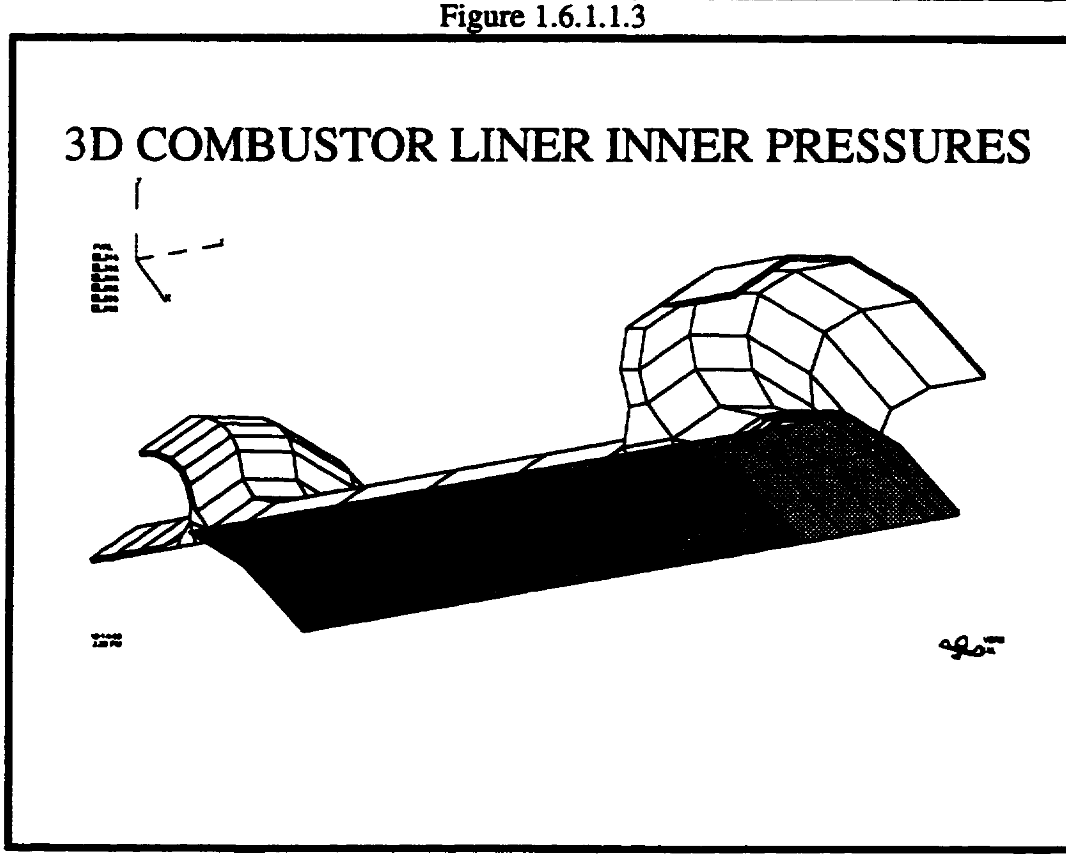


Figure 1.6.1.1.4

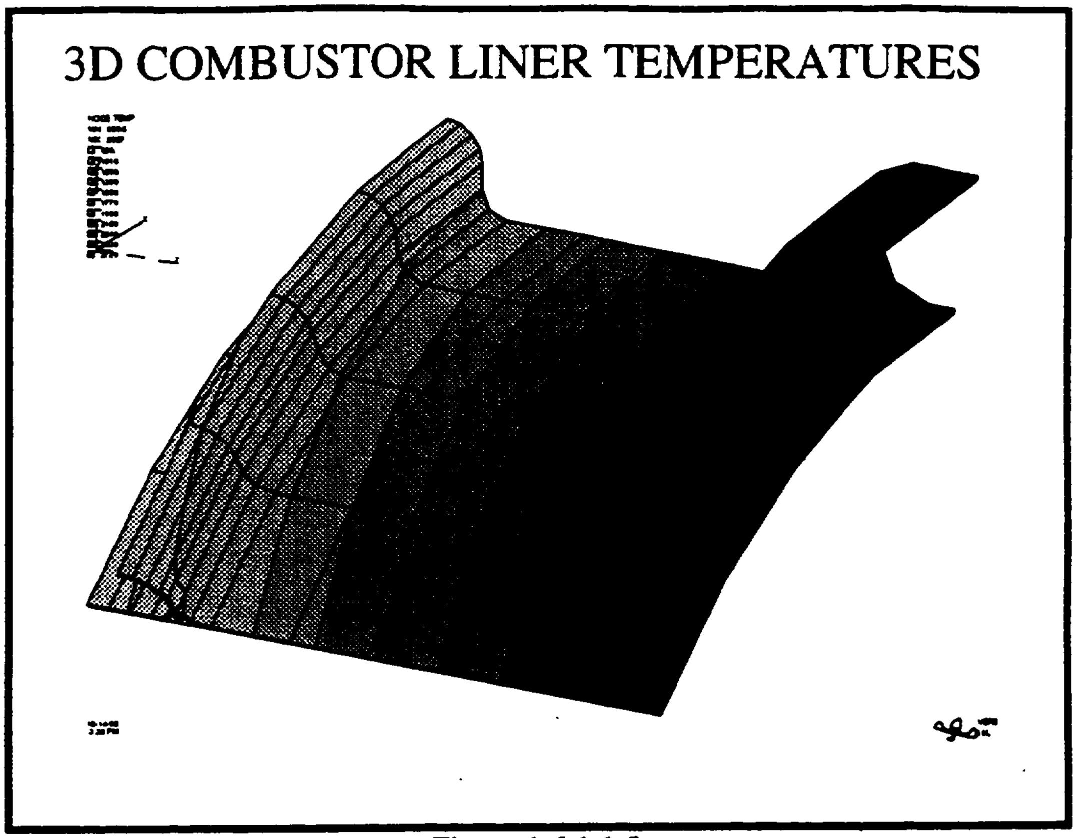


Figure 1.6.1.1.5

Combustor Liner Generator Example (Input is Underlined)

```
> xcosmo
   ##################################################################
                  CCCCC   OOOOOO   SSSSSS   MM    MM   OOOOOO
                  CC      OO  OO   SS       MMM MMM   OO  OO
                  CC      OO  OO   SSSSSS   MM M MM   OO  OO
                  CC      OO  OO       SS   MM M MM   OO  OO
                  CCCCCC  OOOOOO   SSSSSS   MM    MM   OOOOOO
   IT IS  4:32 PM ON 06-30-94 SYSTEM c0401          VERS I.01 06-30-94
   ##################################################################
    This is Version I.01 of COSMO (Production).
    Type NEWS for the latest COSMO News - last update 06-29-94.
         Type NEWS for more information.

                  AVAILABLE SUB-MENUS
   (?)  MENU, (Q)  QUIT, (SYSTEM) SYSTEM
    0 EXIT FROM COSMO

    1 COSMO GEOMETRY                  2 SIESTA FUNCTIONS
   31 CUSTOMIZE COSMO

        CURRENT MAXIMUM SUB-MENU IS 31

        YOU ARE IN THE MAIN MENU (0)
   ENTER DESIRED SUB-MENU BY NUMBER OR ?,G,Q,SYSTEM
CLIN
   ############################################################
       COSMO COMBUSTOR LINER GENERATOR  VERS I.02  06-30-94
             ON c0401         AT  4:32 PM 06-30-94
   ############################################################

   ENTER THE PART NAME (UP TO 8 CHARACTERS)
```

```
part1

     ENTER THE T/BEST NEUTRAL FILE NAME
     OR ENTER "NONE" TO SKIP READING NEUTRAL FILE
neufile

     COMBUSTOR LINER DATA SET BY T/BEST NEUTRAL FILE:
     COMBUSTOR LINER INNER RADIUS =  22.750 IN
     COMBUSTOR LINER LENGTH       =  18.000 IN
     COMBUSTOR LINER THICKNESS    =    .100 IN
     NUMBER OF FUEL NOZZLES       =   4

     THE CURRENT COMBUSTOR LINER PARAMETERS ARE:
            CODE       VALUE                          CODE       VALUE
              1          .00000                         2      22.75000
              3          .00000                         4      18.00000
              5         2.00000                         6        .50000
              7        13.70000                         8        .80000
              9         1.00000                        10       2.00000
             11          .10000                        12        .10000
             13          .10000                        14        .10000
             15          .10000                        16      90.00000
             17        90.00000                        18       1.00000
             19         1.00000                        20        .75000
             21         1.50000                        22       1.50000
             23         1.50000                        24      -1.00000
             25        -1.00000                        26      -1.00000

     ENTER PARAMETER CHANGES (ENTRY CODE, NEW VALUE)
     OR <CR> TO GENERATE THE COMBUSTOR LINER PE2DS
     OR "FILE" TO ENTER PARAMETERS FROM A FILE
     OR "LIST" TO LIST OF THE PARAMETER VALUES
     OR "QUIT" TO QUIT
<CR>

     THE COMBUSTOR LINER PARAMETER FILE IS  part1.par
     ENTER 1 TO GENERATE AN IGES FILE
1
     ################################################################
         UNIFIED INPUT FILE (UIF) READER  VERS I.01  05-25-94
     ################################################################
 STORAGE   VERS I.01   5-19-94
 DATA BASE VERS I.00  04-11-94
 READER    VERS I.04  06-02-94

     INPUT FILE HAS BEEN PROCESSED
     YOUR RANDOM DATA BASE IS ON FILE  37
     ################################################################
           SIESTA GEOMETRY RECREATOR    VERS I.01  05-05-94
     ################################################################
 DATA BASE VERS I.00  04-11-94
     GEOM DATA WILL BE CONVERTED
     REQUIRED INFORMATION FOR IGES FILE HEADER
     ENTER THE PART NAME (UP TO 10 CHAR.):
CLINER
     ENTER YOUR NAME (UP TO 20 CHAR.):
COSMO TEST
     ENTER YOUR ORGANIZATION NAME (UP TO 20 CHAR.):
GEAE
           22 GENTS WRITTEN
     THE IGES GEOMETRY DATA IS ON FILE  40
     THE MODEL GEOMETRY UIF IS part1.guf

     THE MODEL IGES FILE IS part1.igs


     THERE ARE    4 FUEL NOZZLES
```

```
    ENTER THE NUMBER OF CIRCUMFERENTIAL ELEMENTS TO USE
4
    ENTER THE   3 CIRCUMFERENTIAL BIASING PARAMETERS
    ENTER AS PERCENTS, THE SUM BEING LESS THAN 1.0
    ENTER CARRIAGE RETURN FOR EQUAL SPACING
<CR>

    ############################################################
        UNIFIED INPUT FILE (UIF) READER  VERS I.01  05-25-94
    ############################################################
 STORAGE   VERS I.01   5-19-94
 DATA BASE VERS I.00  04-11-94
 READER    VERS I.04  06-02-94

    INPUT FILE HAS BEEN PROCESSED
    YOUR RANDOM DATA BASE IS ON FILE  37
    ############################################################
        SIESTA 2D TO 3D MODEL GENERATOR  VERS I.01  06-23-94
    ############################################################
 DATA BASE VERS I.00  04-11-94
    ENTER STRUCTURAL MODEL PROPAGATION OPTION
          (Q) - EXIT FROM 2D TO 3D, (?) - MENU, (INFO) - INFORMATION
          (0)  DO NOT PROPAGATE TEMPERATURES, MATERIAL CODES
          (1)  PROPAGATE TEMPERATURES FROM 2D TO 3D MODEL
          (2)  PROPAGATE MATERIAL CODES FROM 2D TO 3D MODEL
          (3)  PROPAGATE BOUNDARY SURFACES FROM 2D TO 3D MODEL
          (4)  SHIFT PARENT LAYER NODE AND ELEMENT NAMES
          (5)  DISTRIBUTE POINT WEIGHTS OVER THE ROTATED MODEL
 2. 3.
    ENTER GENERATION OPTION
          (Q) - EXIT FROM 2D TO 3D, (?) - MENU, (INFO) - INFORMATION
          (0) ROTATE A 2D MODEL ABOUT AN AXIS
          (1) STACK A 2D MODEL ALONG AN AXIS
          (2) FILL BETWEEN TWO SURFACES
     0
    YOUR MODEL HAS COORDINATES IN ALL THREE AXES.
    ENTER COORDINATE DESCRIPTION OPTION
          (Q) EXIT 2D TO 3D
          (0) THE MODEL IS IN THE YZ PLANE
          (1) THE MODEL IS IN THE XZ PLANE
          (2) THE MODEL IS IN THE XY PLANE
     0
    ENTER DESIRED ROTATION OPTION
          (Q) - EXIT FROM 2D TO 3D, (?) - MENU, (INFO) - INFORMATION
          (0) EQUALLY SPACED ROTATION
          (1) UNEQUALLY SPACED ROTATION
          (INFO) FOR MORE INFORMATION
     0
    ENTER DESIRED SYMMETRY BOUNDARY CONDITION OPTION
          (0) APPLY NO BOUNDARY CONDITIONS
          (1) APPLY SYMMETRIC BOUNDARY CONDITIONS
          (2) APPLY ANTI-SYMMETRIC BOUNDARY CONDITIONS
          (3) APPLY PSEUDO SYMMETRIC BOUNDARY CONDITIONS
     1
    YOU HAVE SELECTED EQUALLY SPACED ROTATION.
    ENTER THE AXIS YOU WISH TO ROTATE ABOUT AS Y OR Z
 Z
    ENTER THE NUMBER OF ELEMENT LAYERS, THE ANGLE BETWEEN LAYERS,
          THE ANGLE OF THE PARENT LAYER, THE ANGLE OF TWIST,
          THE NODE NAME ADDER, AND THE ELEMENT NAME ADDER
 4. 11.25
                    200 NODES PROCESSED
                    400 NODES PROCESSED
                    600 NODES PROCESSED
                    800 NODES PROCESSED
                    914 NODES PROCESSED
    GENERATING SYMMETRY BOUNDARY CONDITIONS
```

```
          0 NODAL ZERO DISPLACEMENTS PROPAGATED
              27 PE2DS PROCESSED INTO       108 VANSS
    YOUR NEW 3D UIF IS ON FILE 31
    ############################################################
        UNIFIED INPUT FILE (UIF) READER  VERS I.01  05-25-94
    ############################################################
STORAGE   VERS I.01   5-19-94
DATA BASE VERS I.00  04-11-94
READER    VERS I.04  06-02-94

    INPUT FILE HAS BEEN PROCESSED
    YOUR RANDOM DATA BASE IS ON FILE  37

    THE COMBUSTOR LINER 2D MODEL FILE IS part1.2uf
    THE COMBUSTOR LINER 3D MODEL FILE IS part1.3uf

DATA BASE VERS I.0C  04-22-93

    THE COMBUSTOR LINER MODEL WEIGHT IS    32.19      LB
    THE TOTAL COMBUSTOR LINER WEIGHT IS    257.5      LB


    COMBUSTOR LINER MISSION DATA SET BY T/BEST NEUTRAL FILE:
 CASE    ALTITUDE    SPEED      TINLET      TEXIT      PINLET      PEXIT
   1  0.0000E+00  0.0000E+00   889.5       2637.       308.7       290.2
   2  0.0000E+00  0.0000E+00   881.9       2582.       303.5       285.3
   3  0.0000E+00   .2000       899.0       2652.       325.0       305.5
   4    689.0      .3000       905.2       2670.       328.9       309.2
   5    2000.      .4000       911.4       2684.       330.2       310.4
   6  1.0000E+04   .6000       887.3       2632.       279.4       262.6
   7  2.0000E+04   .9000       892.9       2647.       247.8       233.0
   8  3.0000E+04   1.050       850.8       2556.       190.3       178.8
   9  3.6089E+04   1.400       948.5       2776.       218.3       205.2
  10  4.0000E+04   1.600       1057.       3021.       230.6       216.7
  11  4.0000E+04   1.630       1069.       3030.       249.7       234.8
  12  5.0000E+04   1.800       1117.       3027.       181.4       170.6
  13  5.2500E+04   2.000       1196.       3034.       197.7       185.8
  14  5.5000E+04   2.200       1248.       3035.       201.1       189.0
  15  6.0000E+04   2.400       1250.       3035.       163.5       153.7

    ENTER THE CIRCUFERENTIAL TEMPERATURE VARIATION MAGNITUDE
100
    READING A CASE OF TEMPERATURES AND PRESSURES
    THE CASE NUMBER MUST BE SPECIFIED
    ############################################################
        SIESTA RANDOM DATA BASE EDITOR   VERS I.01  05-25-94
    ############################################################
STORAGE   VERS I.01   5-19-94
DATA BASE VERS I.00  04-11-94
READER    VERS I.04  06-02-94
    CASE       1 ENCOUNTERED
    ENTER DESIRED CASE NUMBER TO BE READ
    OR ENTER 'QUIT' TO EXIT READING THE UIF
1
    END OF CASE       1
    ENTER 'Q' TO EXIT READING THE UIF
          'F' TO RUN A SIESTA FUNCTION
          'R' TO READ ADDITIONAL CASES
q

    INPUT FILE HAS BEEN PROCESSED
    EDITING OF RANDOM DATA BASE IS COMPLETE

    THE COMBUSTOR LINER MISSION TEMPERATURES AND PRESSURES
    FOR  15 CASES ARE IN  part1.tuf

    ENTER 1 TO GENERATE A PATRAN NEUTRAL FILE
```

```
1
    ############################################################
        SIESTA PATRAN INPUT GENERATOR    VERS I.00  04-11-94
    ############################################################
 DATA BASE VERS I.00  04-11-94
    ENTER THE PATRAN NEUTRAL FILE TITLE (MAX 40 CHARACTERS)
title
    ENTER THE ANALYSIS CODE:
    1-ANSYS  2-NASTRAN  3-SIESTA  4-PTHERMAL  5-UNIGRAPHICS
1
 $
 $  TOTAL DATA BASE CONTENTS
 $           FIRST     LAST      MIN      MAX  NUMBER
 $   NODES      1      2538        1     2538     914
 $   ELEMS      0         0        1      108     108
 $   BTABS      0         0        1       20      20
 $   VANSS      1       108        1      108     108
 $
    WRITING PATRAN NEUTRAL FILE
         200 NODES WRITTEN
         400 NODES WRITTEN
         600 NODES WRITTEN
         800 NODES WRITTEN
         914 TOTAL NODES WRITTEN
         200 NODAL TEMPERATURES WRITTEN
         400 NODAL TEMPERATURES WRITTEN
         600 NODAL TEMPERATURES WRITTEN
         800 NODAL TEMPERATURES WRITTEN
         914 TOTAL NODAL TEMPERATURES WRITTEN
         276 SETS OF NODAL DISPLACEMENTS WRITTEN
         108 TOTAL VANS WRITTEN
          64 VANS FACE NORMAL PRESSURES WRITTEN

    YOUR PATRAN NEUTRAL FILE IS ON FILE  35
    THE MODEL PATRAN NEUTRAL FILE IS part1.pnf

    ENTER 1 TO GENERATE A CSTEM INPUT FILE
1
    ############################################################
          SIESTA CSTEM DECK GENERATOR  VERS I.00  04-11-94
    ############################################################
 DATA BASE VERS I.00  04-11-94
         TOTAL DATA BASE CONTENTS
        DATA TYPE            MIN     MAX    TOTAL
    ------------------   ------  ------  ------
           NODE                1    2538     914
           VANS                1     108     108

    ENTER THE ANALYSIS IDENTIFICATION (UP TO 80 CHAR.)
Title
         200 NODES WRITTEN
         400 NODES WRITTEN
         600 NODES WRITTEN
         800 NODES WRITTEN
         914 NODES WRITTEN
      108 20-NODED BRICKS WRITTEN
    ENTER THE LAYER SPECIFICATION DATA FILE NAME
    THIS DATA WILL BE ADDED TO THE CSTEM DECK
    OR ENTER 'NONE' TO SKIP ELEMENT LAYERING
NONE
         276 NODAL ANGLE LINES WERE WRITTEN
         276 NODAL FIXITY LINES WERE WRITTEN
      914 NODAL TEMPERATURES WRITTEN
         224 ELEMENT PRESSURES WRITTEN
    YOUR CSTEM DECK IS ON FILE 35
    THE MODEL CSTEM INPUT FILE IS part1.cst
```

```
          YOU ARE IN THE MAIN MENU (0)
     ENTER DESIRED SUB-MENU BY NUMBER OR ?,G,Q,SYSTEM
q

     ####################################################################
       IT IS NOW  4:33 PM ON 06-30-94 WE THANK YOU FOR YOUR PATRONAGE.
     ####################################################################
```

COSMO FUNCTION SUMMARY

FUNCTION:

Component Specific Airfoil Generator

SUB-MENU LOCATION:

COSMO Geometry (Sub-Menu 1, Function 2 or **AGEN**)

PURPOSE:

This function generates 20-noded solid element meshes from an aero coordinate definition. The output is a Unified Input File (UIF). Optionally a Patran Neutral File and/or a CSTEM input deck can be generated.

INPUT FILE(S):

Aero Geometry file (40)

OUTPUT FILE(S):

UIF (afuif)
Patran Neutral File (afpnf)
CSTEM input file (cstdeck)

REQUIRED USER INPUT:

The part name used to name output files must be input. The chordwise, spanwise, and thickness mesh densities must also be specified.

COMMENTS:

This function is particularly useful for the generation of 3D airfoils. (Fan and compressor vanes and blades).

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.02 06-94 will not be reflected in this release of the manual.

1.6.1.2.1. INTRODUCTION

The airfoil mesh generator generates a finite element mesh of user specified size from either aero coordinate data in the form of 'glass master' sections. The number of sections used is arbitrary and does not have to correspond to the desired airfoil mesh size. You have control over mesh density, spacing, and input modification. The mesh will consist of 20-nodel solid elements.

When you run this function, you are prompted for the part name. This part name is used to name output files in COSMO. A part name may be up to eight characters. If the part name is entered as partname, then the 3D UIF would be partname.3uf.

The program refers to the outer part of an airfoil as the tip, and the inner part of an airfoil as the root. The sides of the airfoil are called pressure and suction, the pressure side is on the right when the airfoil is viewed from forward looking aft. For shrouds the tip is in the normal direction of rotation.

This program works in a coordinate system that is relative to the airfoil. The 'CHORDAL' direction is a CARTESIAN axis that is positive when traveling from the leading edge to the trailing edge (this is not the airfoil chord). The 'SPAN' direction is a CARTESIAN axis that is positive when traveling from the root to the tip. The 'THICKNESS' direction is a CARTESIAN axis that is positive in a right hand system with 'SPAN' crossed into 'CHORDAL'. See Figure 1.6.1.2.1.

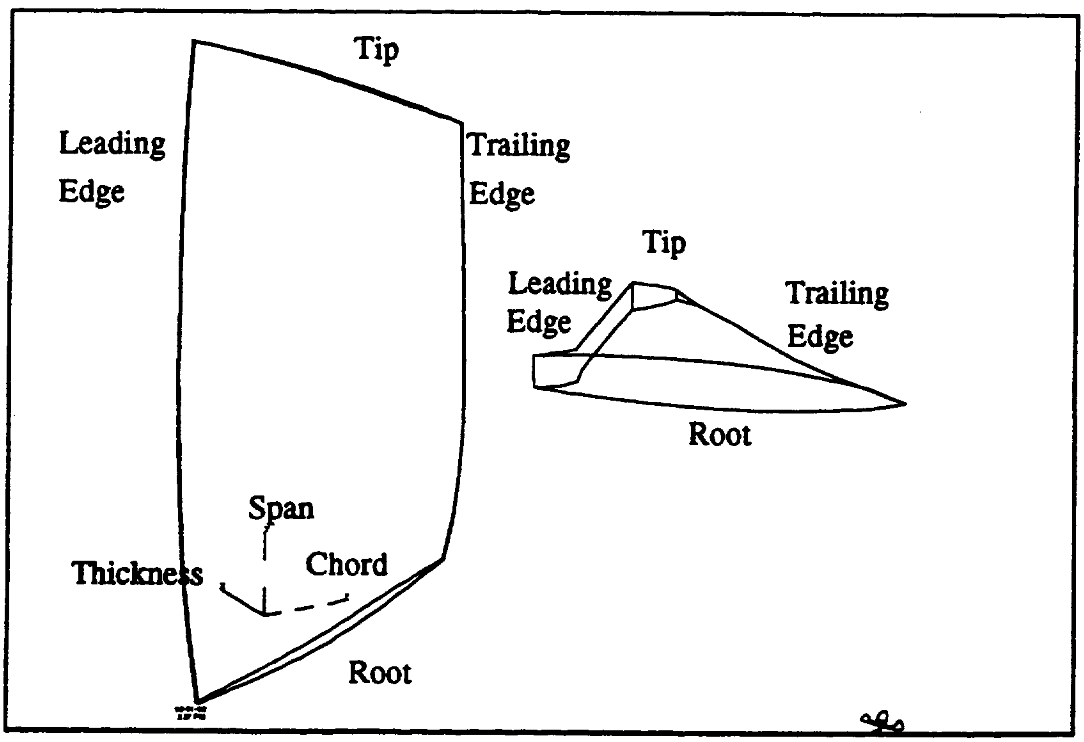


Figure 1.6.1.2.1
Coordinate system

1.6.1.2.2. AIRFOIL FILE DEFINITION

The DIGITIZED GLASS MASTER FILE is the input file format used by this program. This format will allow almost anything to be modeled as an airfoil. This form has a constant even number of pairs per section. The ordering is pairs of pressure and suction side points starting at the leading edge (see Figure 4.17.3.2). Each point has three coordinates, the first is 'SPAN', the second is 'THICKNESS', and the third is minus 'CHORDAL'. See Table 1.6.1.2.1. You must tell the program the number of pairs per section and the number of sections.

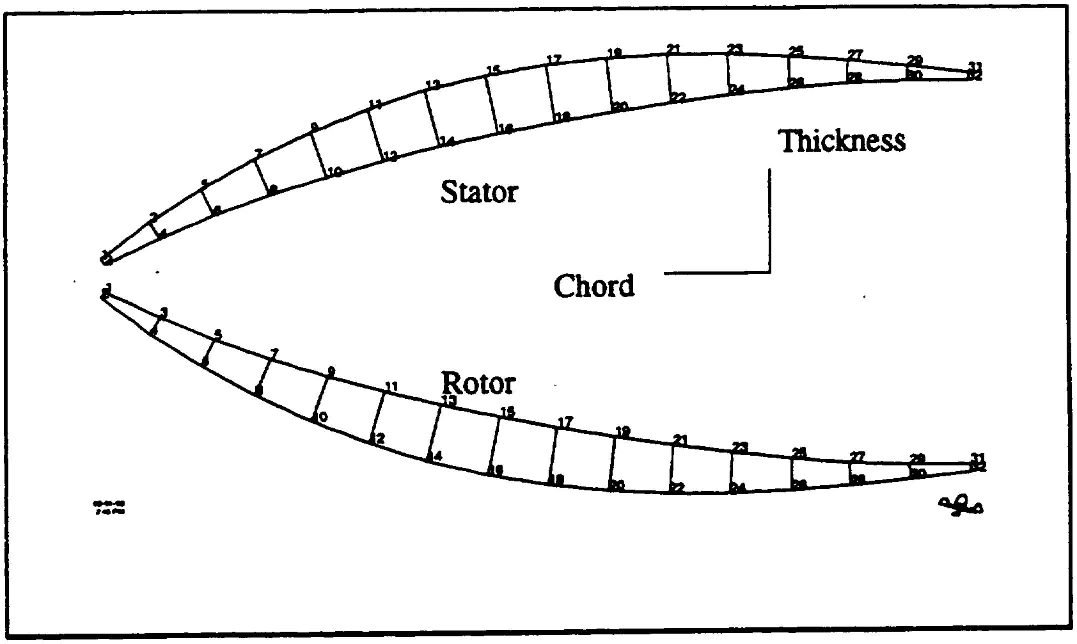


Figure 1.6.1.2.2
Digitized node order

26.0035	-.08969	-1.41029
26.0035	-.16855	-1.405
26.0035	-.09033	-1.47949
26.0035	-.15928	-1.47576
26.0035	-.08998	-1.54177
26.0035	-.15058	-1.5394
26.0035	-.08894	-1.59711
26.0035	-.14269	-1.59594
26.0035	-.08728	-1.64899
26.0035	-.13529	-1.64895
26.0035	-.08006029	-1.8013
26.0035	-.11184	-1.80471
26.2688	.548334	1.518
26.2688	.526686	1.53315
26.2688	.48002	1.37991
26.2688	.4272	1.4106
26.2688	.45869	1.33374
26.2688	.39743	1.36754
26.2688	.43651	1.28423
26.2688	.36618	1.32126

Table 1.6.1.2.1
Digitized Glass Master File

1.6.1.2.3. MODIFYING THE INPUT

There are four input modifications in the mesh generator:

1) Scaling. Glass masters usually are enlarged views of airfoil sections. All of the input coordinates in the aero file are divided by the factor which you enter here. The default scale is 1.

2) Engine and Airfoil Offsets. Digitized data is often entered relative to some airfoil local coordinate system (usually the origin is on the airfoil). This modification allows you to offset from the airfoil local system to the Tilt and Lean coordinate system (usually the origin is on the dovetail), tilt and lean the airfoil, and offset again to the Engine coordinate system (usually the origin is on the engine centerline). See Figure 1.6.1.2.3.

   A total of eight values can be entered here.

   The first three are THICKNESS, SPAN, CHORD offsets added to the rotated airfoil to convert from the Tilt and Lean system to the Engine system (these are the offsets to use if there is no tilt or lean).

   The next three values are THICKNESS, SPAN, CHORD offsets subtracted from the Airfoil coordinates to convert to the Tilt and Lean system (necessary if the tilt and lean are done about 'arbitrary' axes).

   The last two values are the Tilt (about the CHORD), and the Lean (about the THICKNESS). The Airfoil is Tilted then Leaned.

3) Section Switch. Because of differences in terminology between compressor vs. turbine or stator vs. rotor or fixed stator vs. counterrotating aero groups, aero files often have the pressure and suction sides reversed. The result of this will be negative volume elements. A nondefault response will switch the pressure and suction sides.

   Tip Root Switch. All of the input file types have a default definition of whether the sections are entered from the tip or the root. If you have a file that does not match the default for the file type you are using (you get upside down models) you will need this. Enter a nondefault response to switch the order of the sections.

4) Leading Edge/Trailing Edge Averaging. Aero supplies extremely accurate airfoil coordinates. One problem this causes is that the program uses the first and last pairs points for the leading and trailing edges. This can cause distorted edge elements (See Figure 1.6.1.2.4). If this is a problem, you must enter the number of pairs of points for the leading and trailing edge that the program should use to calculate an effective area. The edge thicknesses are modified to maintain this area, ignoring the intermediate pairs of points.

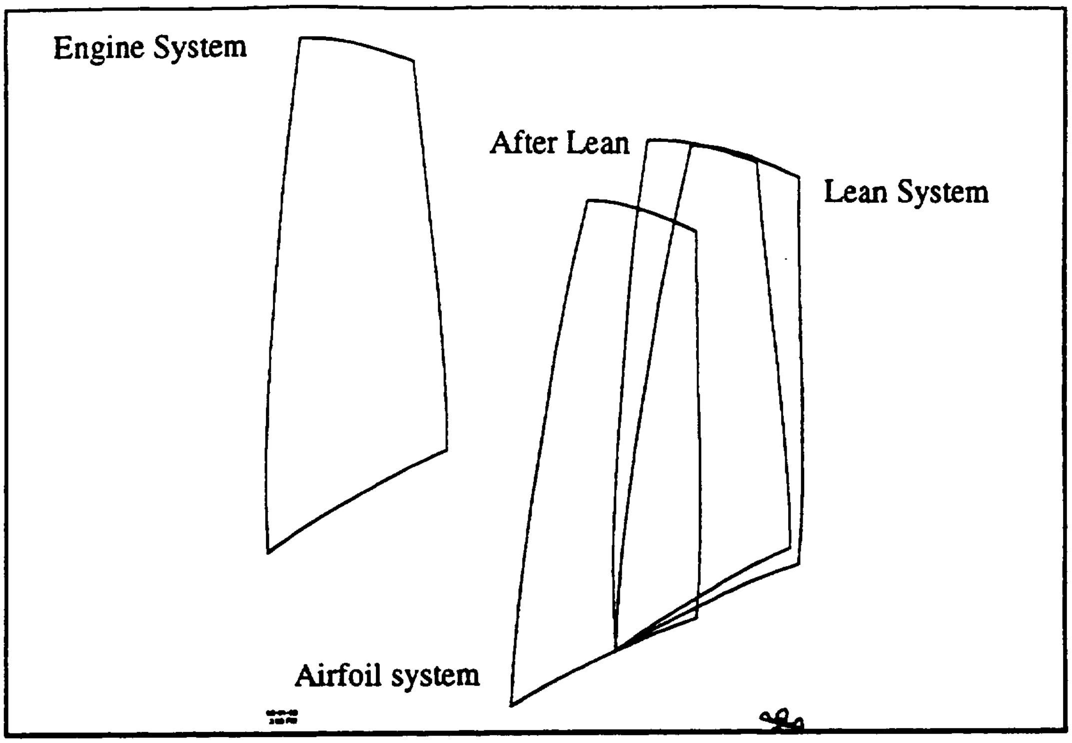


Figure 1.6.1.2.3
Tilt/Lean Coordinate Systems

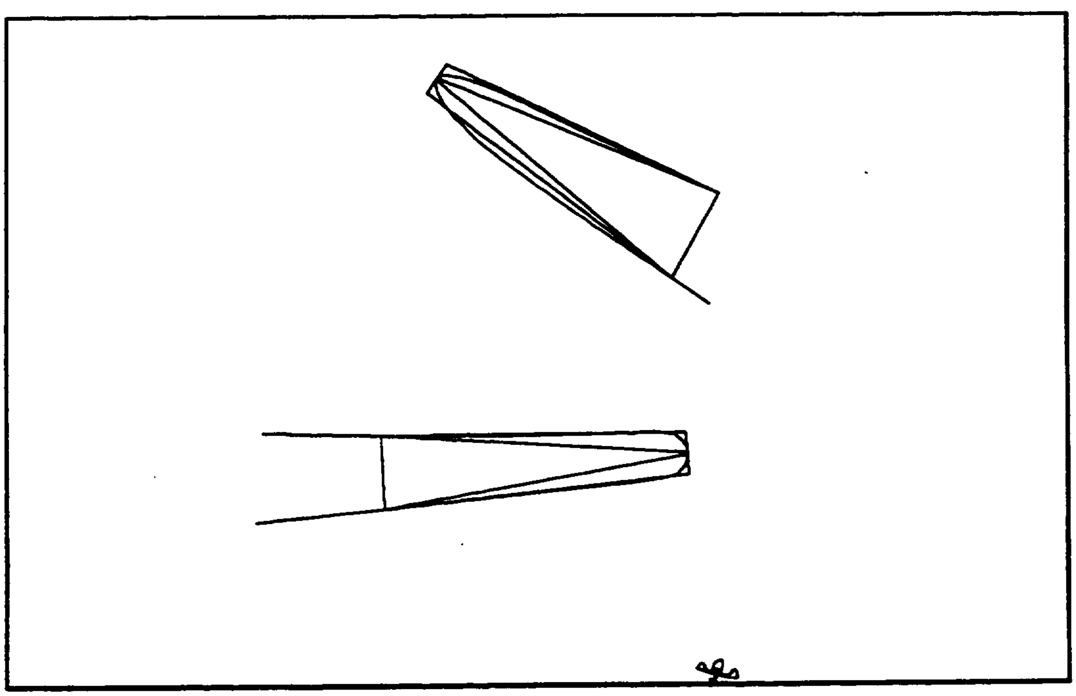


Figure 1.6.1.2.4
Leading Trailing Edge Correction

1.6.1.2.4. CHORD ELEMENT DENSITY AND SPACING

You enter the number of elements in the chord direction. The chord spacing is calculated using weightings. There are two options for generating the weighting values.

Even spacing (0) is the easiest.

User defined weighting (3) is for cases where there is some need for you to control the spacing. You should enter weightings between 0.0 (leading edge) and 1.0 (trailing edge) (note that 0. and 1. are implied) that define the spacing (see Figure 1.6.1.2.5). You may change weightings for each section or use the same spacing for all sections. If you need to enter more numbers than will fit on a single line, end the line with an ampersand (&) and continue on the next line.

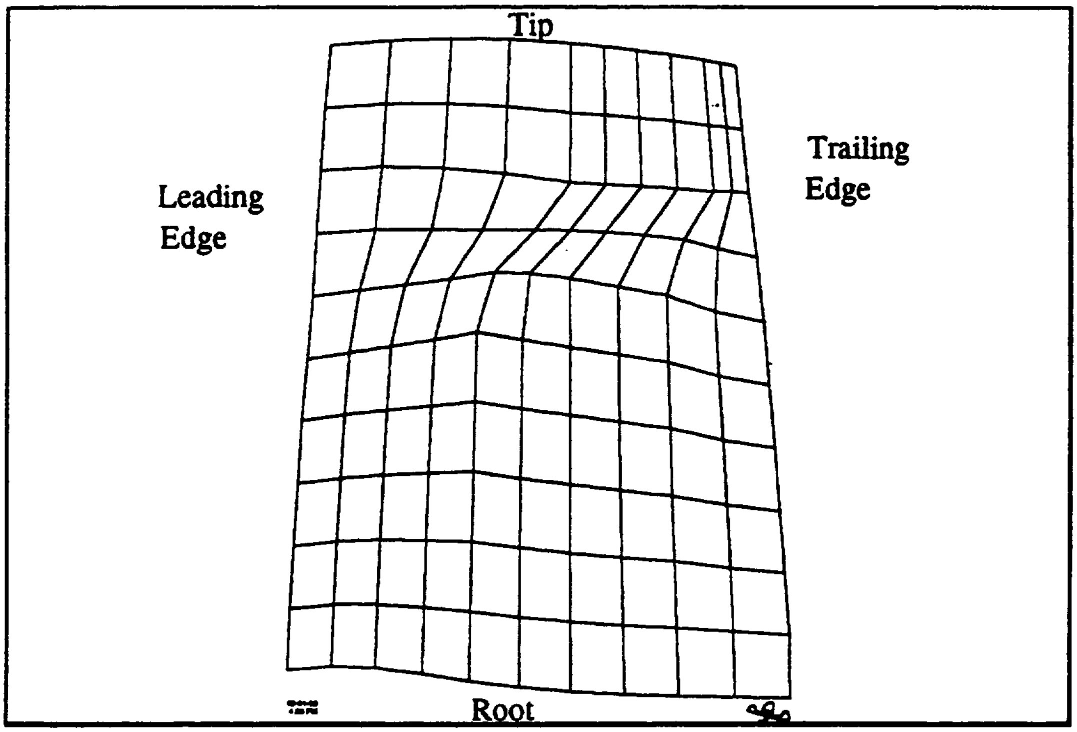


Figure 1.6.1.2.5
Example of User Weighting

1.6.1.2.5. SPAN ELEMENT DENSITY

You must specify the number of elements to be generated in the span direction.

1.6.1.2.6. MULTIPLE ELEMENTS THRU THE THICKNESS

The number of elements thru the thickness must be specified. If one (the default) or two elements thru the thickness are specified no other information is required, even spacing is used. For three of more elements thru the thickness you have three options as to how the thickness spacing is varied. The first options is equally spaced layers, the airfoil is divided evenly (see Figure 1.6.1.2.6).

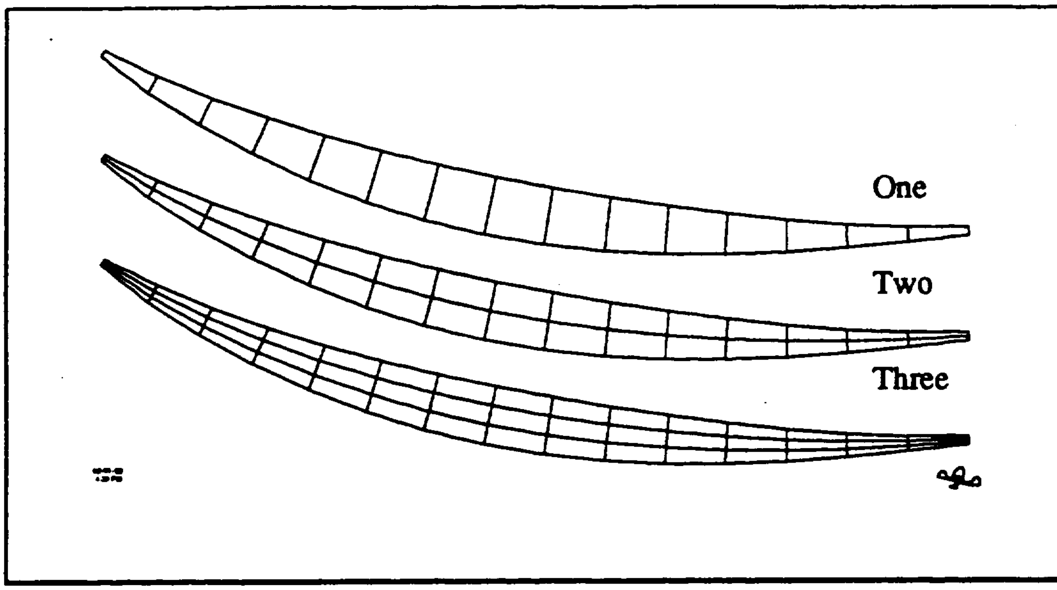


Figure 1.6.1.2.6
Even Spacing of Elements Thru the Thickness

The second option is adding coatings to the airfoil. N-2 coatings may be added to the pressure side (see figure 1.6.1.2.7). N-1-the number of pressure side coatings may be added to the suction side. This leaves at least one layer in the pressure side, the suction side and the 'Real' airfoil. Aside from ridiculous looking airfoils, no errors can be generated with this option.

The third option is subtracting coatings off of the airfoil surface (see Figure 1.6.1.2.7). N-2 coatings may be subtracted from the pressure side. N-1-the number of pressure side coatings may be subtracted from the suction side. This leaves at least one layer in the pressure side, the suction side and the 'real' airfoil. (Called 'real' from the lamination case where this is the starting form).

For the subtraction option if the specified thicknesses for the pressure and suction sides are greater than the aero airfoil thickness the 'real' airfoil thickness would have to be negative. For this negative 'real' thickness problem the user is prompted for a minimum 'real' thickness (it should be obvious that positive but tiny real thickness are as bad as negative thicknesses.)

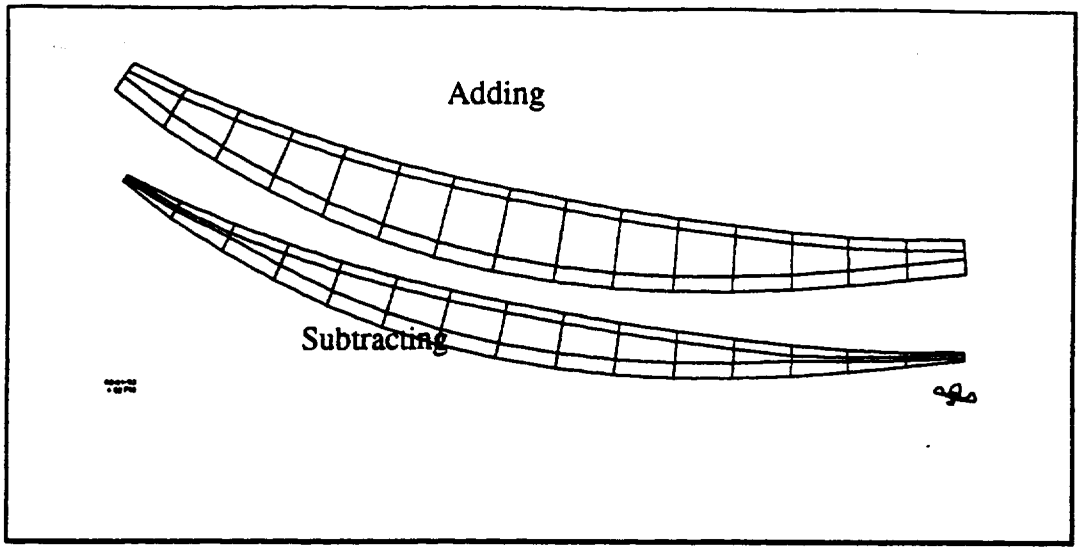


Figure 1.6.1.2.7
Adding and Subtracting Airfoil Coatings

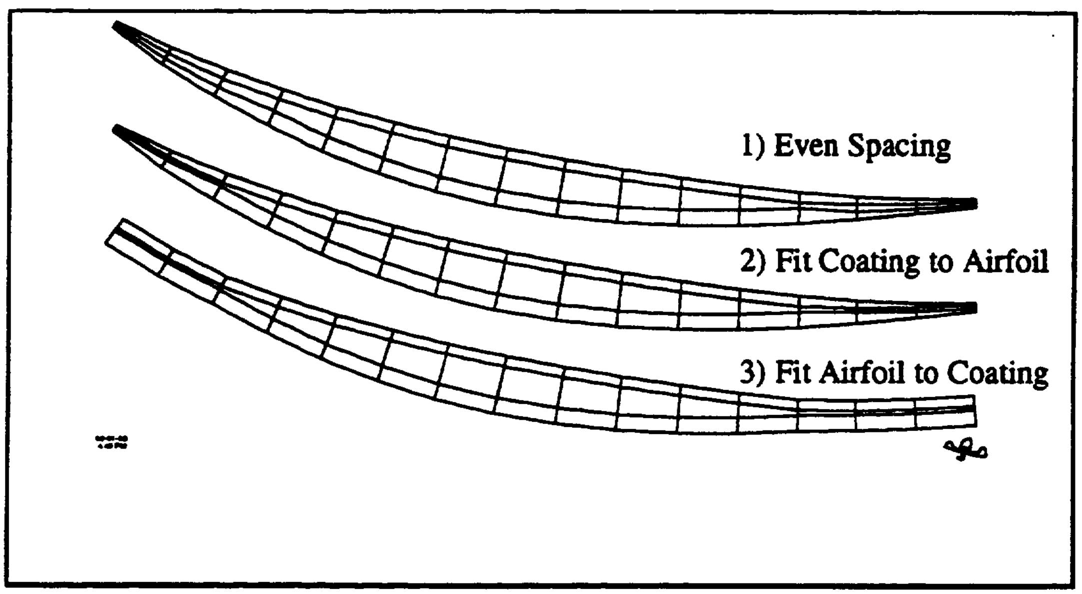


Figure 1.6.2.1.8
Coating Thickness Corrections

For each point on the airfoil surface the thickness is checked and several adjustments can be made if the airfoil is too thin for the thickness requested (see Figure 1.6.2.1.8).

0 No correction, if you are sure the airfoil will always be thicker than the coatings.

1 Even spacing, for this point generate N evenly spaced layers (this may causes coatings to vary wildly from one point to the next).

2 Ratio the coatings to match the airfoil, the 'real' thickness will total to match the minimum real thickness, the overall thickness will total to match the aero thickness. The pressure and suction side thicknesses for this point will not be what was entered.

3 Change the airfoil to match the coatings, the 'real' thickness will total to match the minimum real thickness, the overall thickness will total to the sum of the pressure and suction side thickness plus the minimum real thickness. The airfoil thickness will not be the aero thickness.

4 Enter new coatings, new coatings can be entered for this point.

Correction options 0, 1, 2 and 4 maintain the outer airfoil contour. Options 2 and 3 maintain the 'real' airfoil contour.

Once the number of elements thru the thickness has been established, you will be prompted for the thickness rows and chord rows of elements to eliminate to simulate a hollow airfoil. For example, assume there are 4 elements thru the thickness and 10 elements in the chord direction. Specifying thickness rows 2 and 3 and chord locations 4 and 7, results in the middle two rows of elements being missing for chord locations 4 and 7.

1.6.1.2.7. OUTPUT

The output is a UIF (partname.3uf) of the airfoil model. For airfoils the 'CHORDAL' direction will be axial (Z), the 'SPAN' direction will be radial (Y), and the 'THICKNESS' direction will be tangential (X). For shrouds the 'CHORDAL' direction will be axial (Z), the 'THICKNESS' direction will be radial (Y), and the 'SPAN' direction will be tangential (X). For element types that generate faces, face 1 will be the face seen in the normal engine cross section (ZY). Optionally a Patran Neutral File (partname.pnf) and/or a CSTEM input deck (partname.cst) can be written.

1.6.1.2.8. ERROR MESSAGES

THIS SESSION FILE WAS WRITTEN BY VERSION cccc
THERE ARE NO GUARANTEES THAT IT CAN BE READ BY THIS VERSION
ENTER 1 TO CONTINUE

This is an informational message. You have entered a session file that was written by a prior version of the airfoil mesh generator. Changes in the number of questions, and the interpretation of answers, may mean that this session file will have to be modified. Try it, but watch the responses generated by the program.

1.6.1.2.8. ERROR MESSAGES (CONTINUED)

iiiii PAIRS OF POINTS PER SECTION iiii SECTIONS

This is an informational message. This is what the program has read from the input file, if it is not what you expect, or just plain wrong, the program will probably not get to much further.

MAXIMUM OF iii CHORD STATIONS EXCEEDED

This is a fatal error message. The program has certain internal limits, the number of chord stations is one of them, you have requested too many chordwise elements for the type of element requested. Try again with fewer chordwise elements.

NUMBER PAIRS OF POINTS PER SECTION CHANGED TO iiii

This is an informational message. The input file contains variable numbers of points per section. The number of points in this section is not the same as the previous section.

SECTION ii UNWRAPPED CHORD xx.xxxx

This is an informational message. This is the length of the unwrapped chord for this section. This line follows the center of the airfoil section. This message will help you with weighted spacing, and is a good check on airfoil size.

SECTION II PROJECTED CHORD xx.xxxx

This is an informational message. This is the length of projected chord for this section. This line follows the centerline of the engine. This message will help you with weighted spacing, and is a good check on airfoil size.

WEIGHTING FACTOR OUT OF ORDER x.xxxxx

This is a correctable error message. The weighting factors must be in increasing order from 0. to 1. The function will ask you to reenter all of the factors.

ERROR IN CHORD INTERPOLATION

This is a geometrical error message. The function could not find a location on the chord line to match a weighting factor. The function will attempt to go on, but will probably not work. Try a different chord fitting option.

NO INTERSECTION FOUND, cccccccc STATION ii

This is a geometrical error message. The function could not intersect the outer (pressure or suction) surface with a line normal to the chord. The function will attempt to go on, but will probably not work. Try a different chord fitting option.

1.6.1.2.8. ERROR MESSAGES (CONTINUED)

NO INTERSECTION FOUND CORRECTING ccccccccc STATION ii ii

This is a geometrical error message. While generating a VANS mid-side node the function could not intersect the outer (pressure or suction) surface with a line normal to the chord. The function will attempt to go on, but will probably not work. Try a different chord fitting option.

NUMBER OF NODES iiiii LAST NODE iiiii
NUMBER OF ELEMENTS iiiii LAST ELEMENT iiiii

This is an informational message. This is the size of the model you have created.

NOT ENOUGH (ii) POINTS PER SECTION

This is a fatal error message. There are not enough points per-section to continue.

MAXIMUM OF iii POINTS PER SECTION EXCEEDED

This is a fatal error message. The program has certain internal limits, the number of points per section is one of them.

NOT ENOUGH (ii) INPUT SECTIONS

This is a fatal error message. There are not enough sections to continue.

MAXIMUM OF iii INPUT SECTIONS EXCEEDED

This is a fatal error message. The program has certain internal limits, the number of sections is one of them. Try eliminating a few sections, or create your model in multiple pieces.

CANNOT CORRECT ll LEADING AND jj TRAILING EDGE POINTS
NOT ENOUGH (ii) POINTS PER SECTION

This is a fatal error message. There are not enough points per section to continue. Try using fewer leading/trailing edge points.

ERROR IN CHORD cccccccccc FIT, TYPE ii
(-1 TOO MANY POINTS, -2 NOT IN ORDER, -3,-4 SOLUTION)

This is a fatal error message. You have requested spline type chord interpolation. There is a mathematical reason that your section cannot be fit as a spline. Try linear interpolation.

ERROR READING GLASS MASTER FILE. IER iiiiii NUM iiiiii
DATR x.xxxxxxxe ii x.xxxxxxxe ii x.xxxxxxxe ii

This is a fatal error message. This is probably not a glass master file.

1.6.1.2.8. ERROR MESSAGES (CONTINUED)

cccccc EDGE THICKNESS CHANGED FROM xx.xxxx TO xx.xxxx
CHANGE IN CHORD xx.xxxx

This is an informational message. This is how much the edge correction changed the thickness and chord.

BAD cccc EQUATIONS ii
(-1 TOO MANY POINTS, -2 NOT IN ORDER, -3,-4 SOLUTION)

This is a correctable error message. The set of points entered for tip or root cutting could not be fit as a spline. Try again.

MAXIMUM OF iii PARTITIONS EXCEEDED

This is a fatal error message. The program has certain internal limits, the number of span partitions is one of them, you have requested too many spanwise elements for the type of element requested. Try again with fewer chordwise elements, or create multiple pieces.

ERROR IN SPAN cccccccc FIT, TYPE ii
(-1 TOO MANY POINTS, -2 NOT IN ORDER, -3,-4 SOLUTION)

This is a fatal error message. You have requested spline type span interpolation. There is a mathematical reason that your station cannot be fit as a spline. Try linear interpolation.

STATION ii UNWRAPPED SPAN xxx.xxxx

This is an informational message. This is the length of the unwrapped span for this station. This line follows the center of the airfoil station. This message will help you with weighted spacing, and is a good check on airfoil size.

STATION ii PROJECTED SPAN xxx.xxxx

This is an informational message. This is the length of the projected span for this station. This line follows the span axis. This message will help you with weighted spacing, and is a good check on airfoil size.

ERROR IN SPAN INTERPOLATION

This is a geometrical error message. The function could not find a location on the span line to match a weighting factor. The function will attempt to go on, but will probably not work. Try a different span fitting option.

1.6.1.2.8. ERROR MESSAGES (CONTINUED)

NO INTERSECTION FOUND, cccccccc PARTITION iii

This is a geometrical error message. The function could not intersect the outer (pressure or suction) surface with a line normal to the span. The function will attempt to go on, but will probably not work. Try a different span fitting option.

FOR PARTITION ii STATION ii OVERLAP IN cccccccccc THICKNESS

This is a geometrical error message. The plate thicknesses requested are thicker than the airfoil.

AT PARTITION ii STATION iii THE AIRFOIL IS x.xxxxxx THICK

This is an informational message. The function is reporting the airfoil thickness for some correction option, it may be followed by:

WHICH IS LESS THAN THE SUM OF THE COATINGS x.xxxxxxxx

This is an informational message. The airfoil thickness is less than the coatings to be subtracted from it. This message may be followed by:

THE CORRECTION OPTION IS ii

This is a fatal error message. The function can not continue with this correction option.

1.6.1.2.9. EXAMPLE

Following is an example of running the Component Specific Airfoil Generator. Note: there are 4 elements thru the thickness and the middle two rows of elements are removed for chord locations 4 and 6. See Figure 1.6.1.2.9 for a plot of the airfoil generated.

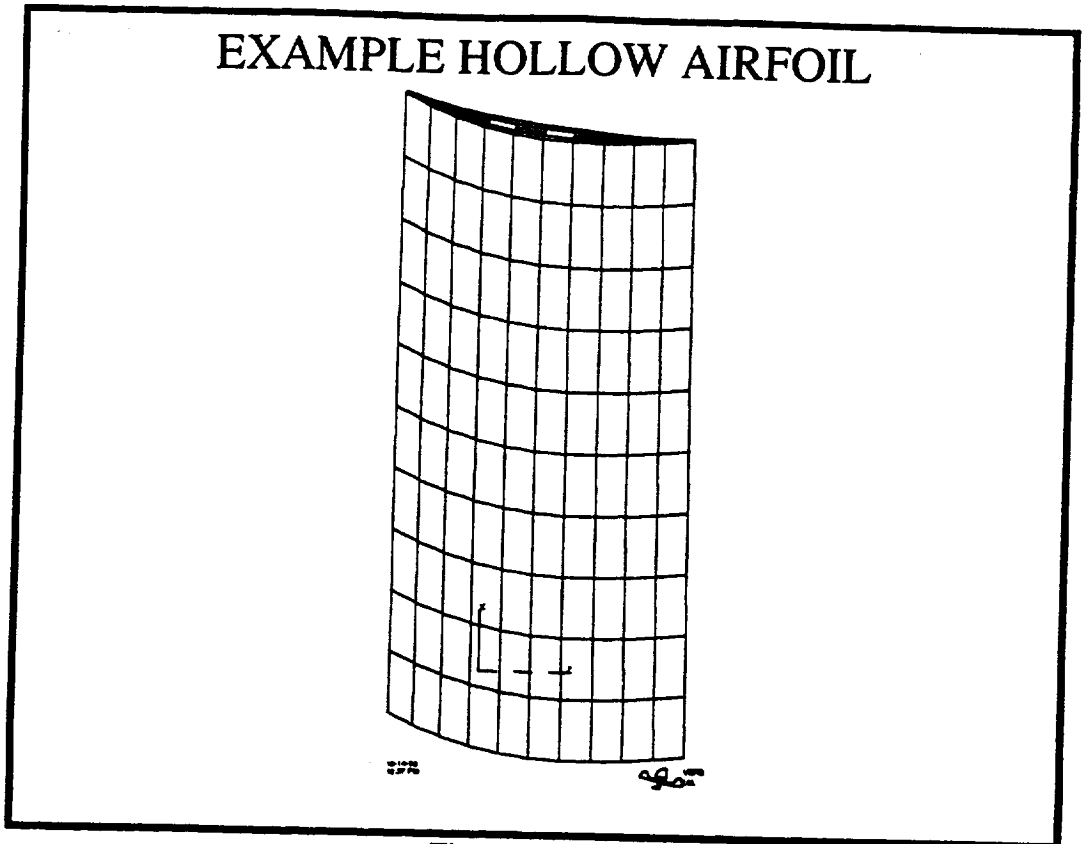


Figure 1.6.1.2.9

Component Specific Airfoil Generator Example (Input is underlined)

```
> xcosmo
##################################################################
                  CCCCC   OOOOOO   SSSSSS   MM    MM   OOOOOO
                  CC      OO  OO   SS       MMM MMM   OO  OO
                  CC      OO  OO   SSSSSS   MM M MM   OO  OO
                  CC      OO  OO       SS   MM M MM   OO  OO
                  CCCCCC  OOOOOO   SSSSSS   MM    MM   OOOOOO
    IT IS  4:27 PM ON 06-30-94 SYSTEM c0401        VERS I.01 06-30-94
##################################################################
     This is Version I.01 of COSMO (Production).
     Type NEWS for the latest COSMO News - last update 06-29-94.
          Type NEWS for more information.

                    AVAILABLE SUB-MENUS
    (?)  MENU, (Q)  QUIT, (SYSTEM) SYSTEM
     0 EXIT FROM COSMO
     1 COSMO GEOMETRY                      2 SIESTA FUNCTIONS
    31 CUSTOMIZE COSMO

         CURRENT MAXIMUM SUB-MENU IS 31

         YOU ARE IN THE MAIN MENU (0)
    ENTER DESIRED SUB-MENU BY NUMBER OR ?,G,Q,SYSTEM
AGEN
    ##############################################################
      COMPONENT SPECIFIC AIRFOIL GENERATOR VERS I.02  06-30-94
              ON c0401        AT  4:27 PM 06-30-94
    ##############################################################

    ENTER THE PART NAME (UP TO 8 CHARACTERS)
part1
    ENTER THE AIRFOIL FILENAME
input.af
    ENTER THE NUMBER OF PAIRS OF POINTS PER SECTION
39
    ENTER THE NUMBER OF AIRFOIL SECTIONS
2
    ENTER 1 TO MODIFY THE INPUT DATA

    ENTER THE NUMBER OF ELEMENTS ALONG THE CHORD
10
    ENTER 0 FOR EVEN CHORD SPACING
          3 FOR USER DEFINED SPACING
0
    ENTER THE NUMBER OF ELEMENTS ALONG THE SPAN
10
    ENTER THE NUMBER OF ELEMENTS ACROSS THE THICKNESS
4
    ENTER 0 FOR THE EQUALLY SPACED METHOD
          1 FOR THE MULITPLE COATING (SKIN) METHOD
0
    ENTER THE ELEMENT CAVITY THICKNESS LAYER NUMBERS
    ENTER CARRIAGE RETURN FOR A SOLID AIRFOIL
2 3
    ENTER THE ELEMENT CAVITY CHORD ROW NUMBERS
4 6
    ##############################################################
      SIESTA AIRFOIL MODELING AIDS PROGRAM VERS I.00  04-11-94
    ##############################################################
    ENTER 0 IF THE FILE IS AN AERO COORDINATE FILE
          1 IF THE FILE CONTAINS DIGITIZED DATA
          2 IF THE FILE IS AN AIG SHROUD FILE
          3 IF THE FILE IS AN AIG AIRFOIL FILE
          4 IF THE FILE IS AN AMP AIRFOIL FILE
 1
    ENTER THE NUMBER OF PAIRS OF POINTS PER SECTION
```

```
39
    ENTER THE NUMBER OF AIRFOIL SECTIONS
2
    ENTER 1 TO MODIFY THE INPUT DATA
0
    ENTER THE NUMBER OF NODES PER ELEMENT (-4,0,3,4,8,9,16,20)
20
    ENTER THE NUMBER OF ELEMENTS ALONG THE CHORD
10
    ENTER 0 FOR EVEN CHORD SPACING
          1 FOR POWER SPACING
          2 FOR BI-POWER SPACING
          3 FOR USER DEFINED SPACING
0
DATA BASE VERS I.00  04-11-94
    SECTION  1 UNWRAPPED CHORD  3.4178
    SECTION  2 UNWRAPPED CHORD  3.4910
    ENTER 0 TO NOT CHANGE THE  TIP FLOWPATH CONTOUR
          1 TO DEFINE A PLANAR FLOWPATH CONTOUR
          2 TO DEFINE A CONICAL FLOWPATH CONTOUR
0
    ENTER 0 TO NOT CHANGE THE ROOT FLOWPATH CONTOUR
          1 TO DEFINE A PLANAR FLOWPATH CONTOUR
          2 TO DEFINE A CONICAL FLOWPATH CONTOUR
0
    ENTER THE NUMBER OF ELEMENTS ALONG THE SPAN
10
    ENTER 0 FOR EVEN SPAN SPACING
          1 FOR POWER SPACING
          2 FOR BI-POWER SPACING
          3 FOR USER DEFINED SPACING
0
    STATION  1 UNWRAPPED SPAN 10.0001
    STATION  2 UNWRAPPED SPAN 10.0000
    STATION  3 UNWRAPPED SPAN 10.0000
    STATION  4 UNWRAPPED SPAN 10.0000
    STATION  5 UNWRAPPED SPAN 10.0000
    STATION  6 UNWRAPPED SPAN 10.0000
    STATION  7 UNWRAPPED SPAN 10.0000
    STATION  8 UNWRAPPED SPAN 10.0000
    STATION  9 UNWRAPPED SPAN 10.0000
    STATION 10 UNWRAPPED SPAN 10.0000
    STATION 11 UNWRAPPED SPAN 10.0000
    STATION 12 UNWRAPPED SPAN 10.0000
    STATION 13 UNWRAPPED SPAN 10.0000
    STATION 14 UNWRAPPED SPAN 10.0000
    STATION 15 UNWRAPPED SPAN 10.0000
    STATION 16 UNWRAPPED SPAN 10.0001
    STATION 17 UNWRAPPED SPAN 10.0001
    STATION 18 UNWRAPPED SPAN 10.0001
    STATION 19 UNWRAPPED SPAN 10.0001
    STATION 20 UNWRAPPED SPAN 10.0002
    STATION 21 UNWRAPPED SPAN 10.0002
    ENTER THE NUMBER OF ELEMENTS ACROSS THE THICKNESS
-4
    ENTER 0 FOR THE EQUALLY SPACED METHOD
          1 FOR THE MULITPLE COATING (SKIN) METHOD
0
    ENTER THE ELEMENT CAVITY THICKNESS LAYER NUMBERS
    ENTER CARRIAGE RETURN FOR A SOLID AIRFOIL
2 3
    ENTER THE ELEMENT CAVITY CHORD ROW NUMBERS
4 6
    ENTER FIRST NODE NUMBER, FIRST ELEMENT NUMBER,
          SPAN NODE NUMBER ADDER, AND SPAN ELEMENT NUMBER ADDER
1 1
    NUMBER OF NODES        2189 LAST NODE        2189
```

```
    NUMBER OF ELEMENTS       360 LAST ELEMENT       400
    NUMBER OF BOUNDARY SURFACES        6
    NUMBER OF AIRFOIL PAIRED NODE STRUTS      121 WRITTEN TO FILE  32
    ENTER 1 FOR FIXED TIP  BOUNDARY CONDITIONS
0
    ENTER 1 FOR FIXED ROOT BOUNDARY CONDITIONS
0
    YOUR UIF IS ON FILE 31
    ############################################################
        UNIFIED INPUT FILE (UIF) READER  VERS I.01  05-25-94
    ############################################################
STORAGE   VERS I.01   5-19-94
DATA BASE VERS I.00  04-11-94
READER    VERS I.04  06-02-94

    INPUT FILE HAS BEEN PROCESSED
    YOUR RANDOM DATA BASE IS ON FILE  37

    THE AIRFOIL MODEL FILE IS part1.3uf

    ENTER 1 TO GENERATE A PATRAN NEUTRAL FILE
1
    ############################################################
        SIESTA PATRAN INPUT GENERATOR    VERS I.00  06-28-94
    ############################################################
DATA BASE VERS I.00  04-11-94
    ENTER THE PATRAN NEUTRAL FILE TITLE (MAX 40 CHARACTERS)
COSMO AIRFOIL
    ENTER THE ANALYSIS CODE:
    1-ANSYS  2-NASTRAN  3-SIESTA  4-PTHERMAL  5-UNIGRAPHICS
1
 $
 $   TOTAL DATA BASE CONTENTS
 $            FIRST    LAST      MIN      MAX  NUMBER
 $    NODES       1    2189        1     2189    2189
 $    ELEMS       0       0        1      400     360
 $    VANSS       1     400        1      400     360
 $
    WRITING PATRAN NEUTRAL FILE
         500 NODES WRITTEN
        1000 NODES WRITTEN
        1500 NODES WRITTEN
        2000 NODES WRITTEN
        2189 TOTAL NODES WRITTEN
         360 TOTAL VANS WRITTEN
           0 VANS FACE NORMAL PRESSURES WRITTEN

    YOUR PATRAN NEUTRAL FILE IS ON FILE  35
    THE MODEL PATRAN NEUTRAL FILE IS part1.pnf

    ENTER 1 TO GENERATE A CSTEM INPUT FILE
1
    ############################################################
          SIESTA CSTEM DECK GENERATOR  VERS I.00  04-11-94
    ############################################################
DATA BASE VERS I.00  04-11-94
         TOTAL DATA BASE CONTENTS
        DATA TYPE          MIN     MAX    TOTAL
    ------------------   ------  ------  ------
          NODE               1    2189    2189
          VANS               1     400     360

    ENTER THE ANALYSIS IDENTIFICATION (UP TO 80 CHAR.)
COSMO AIRFOIL
         500 NODES WRITTEN
        1000 NODES WRITTEN
        1500 NODES WRITTEN
```

```
    2000 NODES WRITTEN
    2189 NODES WRITTEN
   360 20-NODED BRICKS WRITTEN
  ENTER THE LAYER SPECIFICATION DATA FILE NAME
  THIS DATA WILL BE ADDED TO THE CSTEM DECK
  OR ENTER 'NONE' TO SKIP ELEMENT LAYERING
NONE
  YOUR CSTEM DECK IS ON FILE 35
  THE MODEL CSTEM INPUT FILE IS part1.cst

       YOU ARE IN THE MAIN MENU (0)
  ENTER DESIRED SUB-MENU BY NUMBER OR ?,G,Q,SYSTEM
q

  ###################################################################
    IT IS NOW  4:28 PM ON 06-30-94 WE THANK YOU FOR YOUR PATRONAGE.
  ###################################################################
```

COSMO FUNCTION SUMMARY

FUNCTION:

Disk Model Generator

SUB-MENU LOCATION:

COSMO Geometry (Sub-Menu 1, Function 3 or **DISK**)

PURPOSE:

This function generates 2D and 3D disk models using a set of parameters to define the disk cross section. The output is a Unified Input File (UIF). Optionally an IGES file, Patran Neutral File and/or a CSTEM input deck can be generated.

INPUT FILE(S):

Disk Parameter File (52)

OUTPUT FILE(S):

Disk Parameter File (partname.par)
2D IGES file (partname.igs)
2D Mesh UIF (partname.2uf)
2D Shell UIF (partname.suf)
3D Disk UIF (partname.3uf)
3D Patran Neutral File (partname.pnf)
3D CSTEM input file (partname.cst)

REQUIRED USER INPUT:

The part name used to name output files must be input. The disk parameters, number of blades, number of circumferential elements and element circumferential spacing must also be specified.

COMMENTS:

NONE

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.01 06-94 will not be reflected in this release of the manual.

1.6.1.3.1. INTRODUCTION

The disk model generator generates a finite element mesh of a disk using a set of specified parameters to define the disk cross section. In the future, certain parameters can be read from a T/BEST Neutral File. The output is a Unified Input File (UIF). Optionally a 2D mesh and geometry UIF, a 2D Shell UIF, a 2D IGES file, a Patran Neutral File and/or a CSTEM input deck can be generated. The 3D mesh will consist of 8-nodel solid elements.

When you run this function, you are prompted for the part name. This part name is used to name output files in COSMO. A part name may be up to eight characters. If the part name is entered as partname, then the 3D UIF would be partname.3uf.

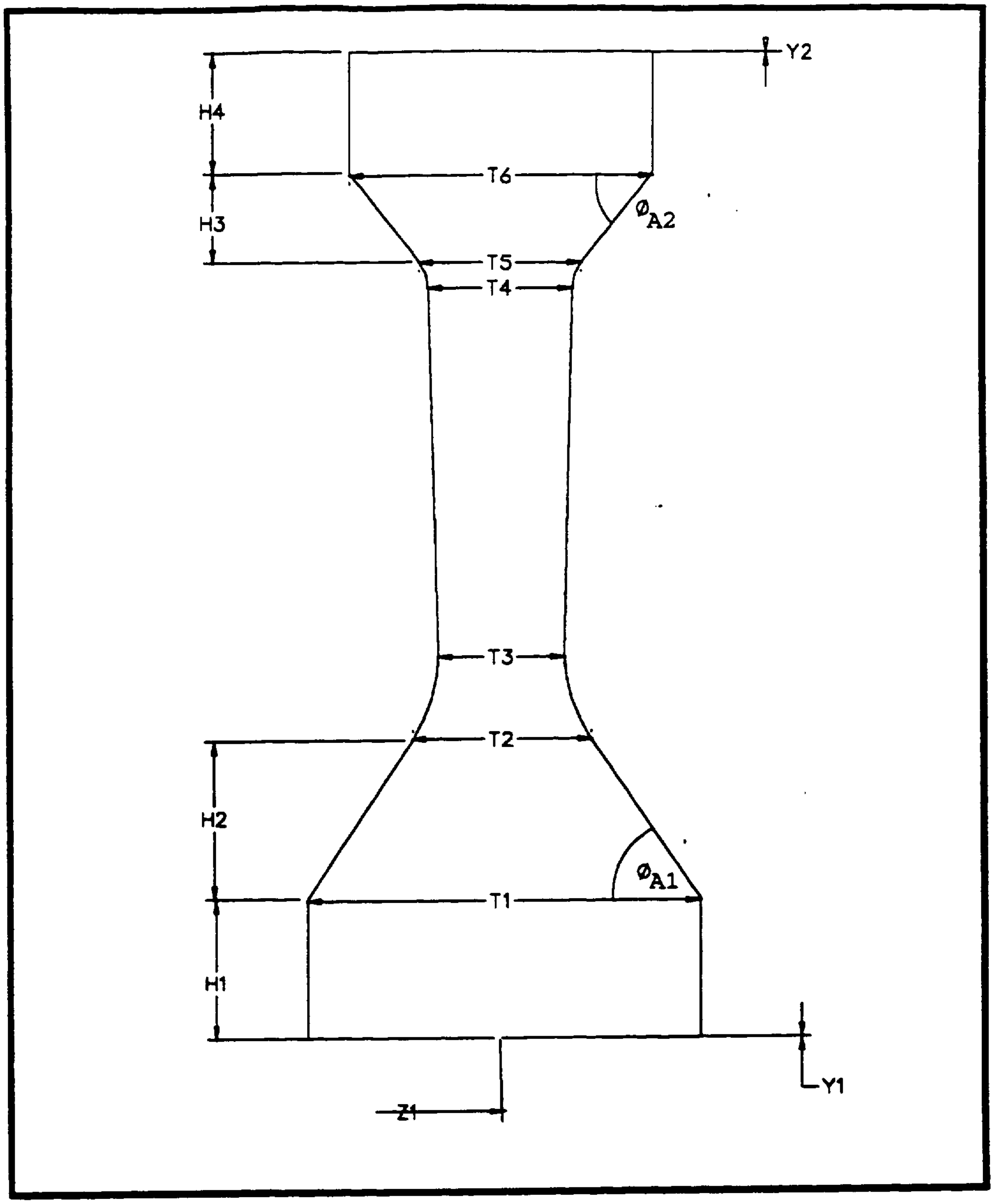
1.6.1.3.2. DISK PARAMETERS

The disk cross section is defined by 13 geometric parameters. Figure 1.6.1.3.1 shows the disk cross section and parameters. The parameters can be input interactively or using an input file. In the future, certain parameters can be set by the T/BEST Neutral File.

There are also three control parameters:

14	IGES Write
15	Patran Neutral File Write
16	CSTEM Deck Write

The possible values for the control parameters are: -1 prompt user for the process, 0 skip the process, or 1 perform the process. The default values of these parameters is -1.



Code	Name	Code	Name
1	Z1	2	Y1
3	Y2	4	H1
5	H2	6	H3
7	H4	8	T1
9	T2	10	T3
11	T4	12	T5
13	T6		

Figure 1.6.1.3.1
COSMO Disk Model Parameters
Z = Z coordinate, Y = Y coordinate, H = Height, T = Thickness

1.6.1.3.3. DISK GEOMETRY CHECKS

Once the disk parameters have been specified, the disk geometry is checked to make sure that a valid disk geometry can be generated from the parameters. There are several different checks:

All geometric parameters (2-13) must be greater than 0. (Z1 can be 0.)
Y2 must be greater than Y1 for a positive disk height
T1 must be greater than T2
T2 must be greater than T3
T5 must be greater than T4
T6 must be greater than T5
Y2-Y1 = disk height must be greater than the sum of the heights H1+H2+H3+H4
$\varnothing_{A1}$ and $\varnothing_{A2}$ must be less than 60° (see figure 1.6.1.3.1)

The angles checks are needed to ensure that a radius can be generated between the bore and the web and also between the rim and the web. If any of these geometry checks fail, an error message is written to the screen and you are prompted to enter new disk parameters.

1.6.1.3.4. DISK MODEL GENERATION

Once the a valid disk geometry has been checked, the 2D cross section model is generated. You are prompted to enter 1 to write out the 2D IGES file. If you select this option, you will be asked for the part name, your name, and your organization. This data is written to the IGES file. The IGES file is written as <u>partname.igs</u>. Next, a 2D mapped mesh is created for the cross section. Currently, you have to answer several questions to generate the 2D mesh. In the future, this will be automated.

The Master Region Mesh Generator (Sub-Menu 2, Function 10 or MESH) generates a 2D mapped mesh from a master region definition. The details of mesh generation and master regions are in the SIESTA manual. To generate the 2D mesh, enter the following commands:

```
  4    $ Generate Mesh
  1    $ Set the Element Size for the mesh
 .1    $ Element Size set to 0.1 in
<CR>   $ Do not skip mesh generation
<CR>   $ Use the default node and element numbering
  2    $ Write the Mesh UIF
 -1    $ Quit and return to Disk Model Generator.
```

The 2D Mesh UIF is written as <u>partname.2uf</u>. A separate 2D Shell UIF is written as <u>part-name.suf</u>. This UIF could be used for a Shell model of the disk or as input to a disk analysis program.

The 2D mesh is then rotated into a 3D sector model of the disk. The 3D model is a symmetry model of one blade. The model is rotated about the Z axis. You will be prompted for the number of blades and the number of elements circumferentially in the model. Then you will be prompted for the circumferential spacing. Enter a carriage return to use equal spacing. Enter circumferential percentages with the sum being less than 1.0. For example, for 4 circumferential elements, biasing percentages of 0.10 0.23 0.34 with place the nodal sections at 0, 10%, 33%, 67%, and 100% of the sector angle. The 3D disk model is then generated. Also the disk weight is calculated based on a density of 0.3 lb/in^3. The output is a UIF (partname.3uf) of the disk model. The model is a sector model with symmetry boundary conditions. Optionally a Patran Neutral File (partname.pnf) and/or a CSTEM input deck (partname.cst) can be written.

1.6.1.3.5. EXAMPLE

Following is an example of running the Disk Model Generator. See Figures 1.6.1.3.2 - 1.6.1.3.3 for plots of the disk model generated.

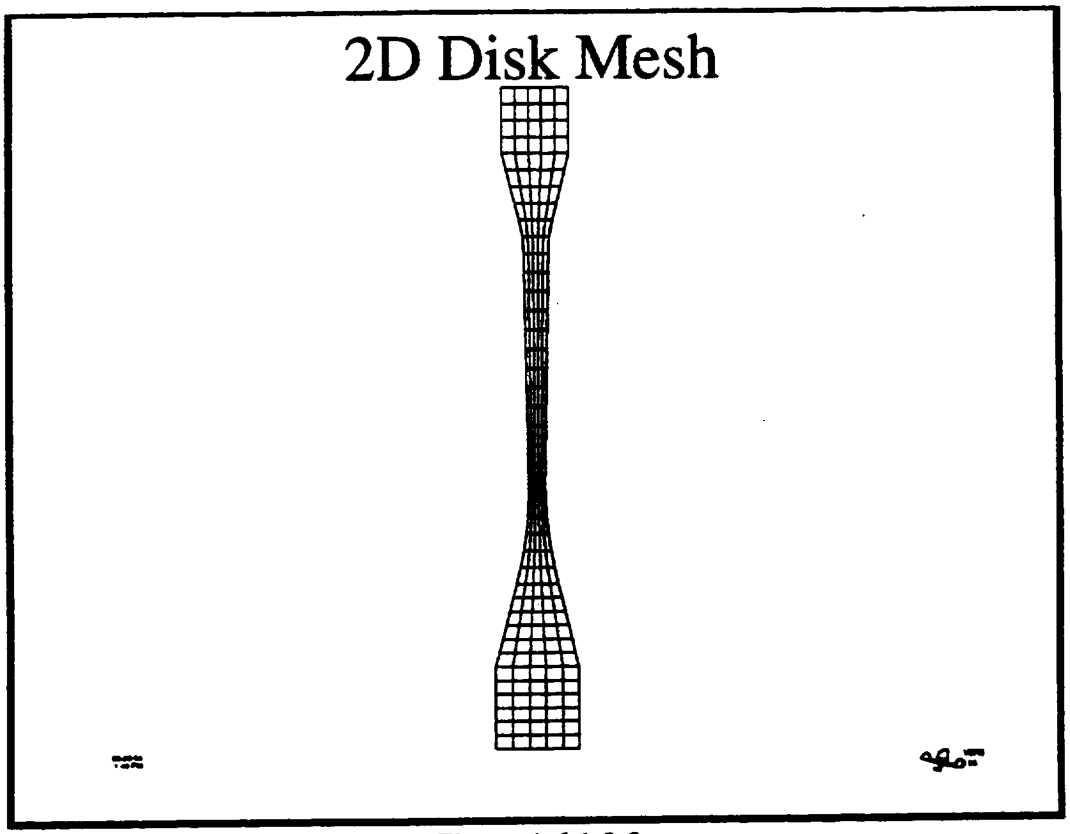


Figure 1.6.1.3.2

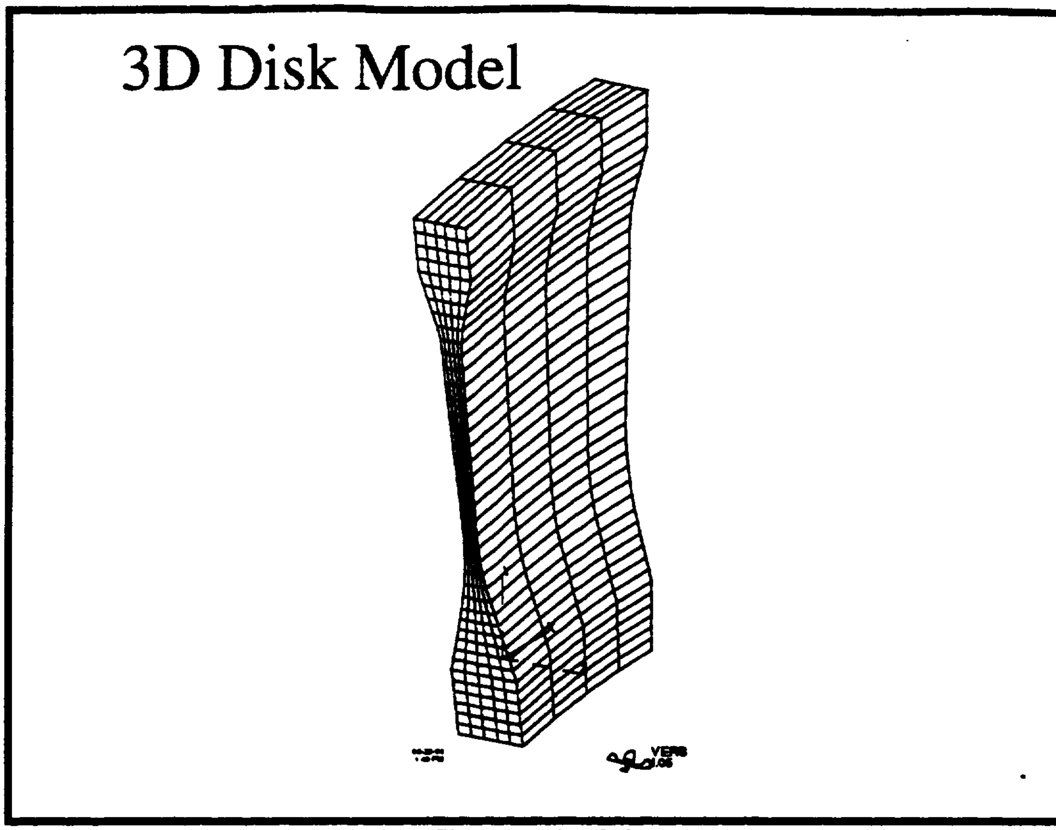


Figure 1.6.1.3.3

Disk Model Generator Example (Input is Underlined)

```
> xcosmo
    ##################################################################
                 CCCCC    OOOOOO    SSSSSS   MM    MM   OOOOOO
                 CC       OO  OO    SS       MMM MMM    OO  OO
                 CC       OO  OO    SSSSSS   MM M MM    OO  OO
                 CC       OO  OO        SS   MM M MM    OO  OO
                 CCCCCC   OOOOOO    SSSSSS   MM    MM   OOOOOO
    IT IS  1:51 PM ON 06-30-94 SYSTEM c0401        VERS I.01 06-30-94
    ##################################################################
     This is Version I.01 of COSMO (Production).
     Type NEWS for the latest COSMO News - last update 06-29-94.
          Type NEWS for more information.

                    AVAILABLE SUB-MENUS
    (?)  MENU, (Q)  QUIT, (SYSTEM) SYSTEM
     0 EXIT FROM COSMO

     1 COSMO GEOMETRY                   2 SIESTA FUNCTIONS
    31 CUSTOMIZE COSMO

         CURRENT MAXIMUM SUB-MENU IS 31

         YOU ARE IN THE MAIN MENU (0)
    ENTER DESIRED SUB-MENU BY NUMBER OR ?,G,Q,SYSTEM
DISK
    ###########################################################
          COSMO DISK MODEL GENERATOR   VERS I.01  06-30-94
              ON c0401        AT  1:51 PM 06-30-94
    ###########################################################

    ENTER THE PART NAME (UP TO 8 CHARACTERS)
part1
    THE CURRENT DISK MODEL PARAMETERS ARE:
```

```
          CODE       VALUE                      CODE      VALUE
           1         10.00000                    2        10.00000
           3         14.00000                    4          .50000
           5           .50000                    6          .40000
           7           .40000                    8          .50000
           9           .25000                   10          .10000
          11           .15000                   12          .20000
          13           .40000                   14        -1.00000
          15         -1.00000                   16        -1.00000

     ENTER PARAMETER CHANGES (ENTRY CODE, NEW VALUE)
     OR <CR> TO GENERATE THE DISK MODEL GEOMETRY
     OR 'FILE' TO ENTER PARAMETERS FROM A FILE
     OR 'LIST' TO LIST OF THE PARAMETER VALUES
     OR 'QUIT' TO QUIT
<CR>
     THE DISK MODEL PARAMETER FILE IS part1.par
     ENTER 1 TO GENERATE AN IGES FILE
1
     ################################################################
         UNIFIED INPUT FILE (UIF) READER  VERS I.01  05-25-94
     ################################################################
 STORAGE   VERS I.01   5-19-94
 DATA BASE VERS I.00  04-11-94
 READER    VERS I.04  06-02-94

     INPUT FILE HAS BEEN PROCESSED
     YOUR RANDOM DATA BASE IS ON FILE  37
     ################################################################
           SIESTA GEOMETRY RECREATOR    VERS I.01  05-05-94
     ################################################################
 DATA BASE VERS I.00  04-11-94
     GEOM DATA WILL BE CONVERTED
     ENTER THE PART NAME (UP TO 10 CHAR.):
DISK
     ENTER YOUR NAME (UP TO 20 CHAR.):
COSMO TEST
     ENTER YOUR ORGANIZATION NAME (UP TO 20 CHAR.):
GEAE
           16 GENTS WRITTEN
     THE IGES GEOMETRY DATA IS ON FILE  40
     THE COSMO DISK IGES FILE IS part1.igs
     ################################################################
         UNIFIED INPUT FILE (UIF) READER  VERS I.01  05-25-94
     ################################################################
 STORAGE   VERS I.01   5-19-94
 DATA BASE VERS I.00  04-11-94
 READER    VERS I.04  06-02-94

     INPUT FILE HAS BEEN PROCESSED
     YOUR RANDOM DATA BASE IS ON FILE  37
     ################################################################
     MASTER REGION MESH GENERATOR (MR. MESH)  VERS I.01  05-09-94
     ################################################################
 STORAGE   VERS I.01   5-19-94
 DATA BASE VERS I.00  04-11-94
     THERE ARE:
              42 MASTER NODES
              16 MASTER REGIONS
              17 STRIPS
               1 MESH ISLANDS
     SELECT DESIRED OPTION
          -1 - QUIT (DO NOT SAVE MESH)
           0 - PLOT MESH
           1 - BANDWIDTH REDUCTION
           2 - WRITE UIF
           3 - DEFINE/MODIFY MESH
```

```
          4 - GENERATE MESH
         10 - QUIT (SAVE MESH ON RDB)
4
 STORAGE   VERS I.01   5-19-94
 DATA BASE VERS I.00  04-11-94
     THERE ARE STILL      64 UNDEFINED EDGES
     HOW WOULD YOU LIKE TO DEFINE THE MESH ON THESE EDGES
          0 - ASPECT RATIO
          1 - ELEMENT SIZE OR ANGLE
          2 - CONSTANT NUMBER OF ELEMENTS
1
     ENTER MAXIMUM ELEMENT SIZE AND MAXIMUM ARC ANGLE
.1
     ESTIMATED MODEL SIZE
             336 NODES,
             200 ELEMENTS

     DO YOU WANT TO SKIP GENERATION? (Y/N)
<CR>
     ENTER NODE AND ELEMENT NUMBER OFFSETS
     (OR RETURN TO START WITH NODE 1 AND ELEMENT 1)
<CR>
     MESHING ISLAND       1
          MESHING REGION       1
          MESHING REGION       2
          MESHING REGION       3
          MESHING REGION       4
          MESHING REGION       5
          MESHING REGION       6
          MESHING REGION       7
          MESHING REGION       8
          MESHING REGION       9
          MESHING REGION      10
          MESHING REGION      11
          MESHING REGION      12
          MESHING REGION      13
          MESHING REGION      14
          MESHING REGION      15
          MESHING REGION      16
     ACTUAL MODEL SIZE
             246 NODES,
             200 ELEMENTS

     SELECT DESIRED OPTION
         -1 - QUIT (DO NOT SAVE MESH)
          0 - PLOT MESH
          1 - BANDWIDTH REDUCTION
          2 - WRITE UIF
          3 - DEFINE/MODIFY MESH
          4 - GENERATE MESH
         10 - QUIT (SAVE MESH ON RDB)
2
     ############################################################
             SIESTA RDB TO UIF WRITER VERS I.02  06-20-94
     ############################################################
 DATA BASE VERS I.00  04-11-94
 FULL DUMP OF RDB

     PRIMARY KEY SET TO NLIM
     SECONDARY KEYS RESET TO BNOD LNOD BELM LELM BMND LMND BMRG LMRG
       BGND LGND BGEO LGEO
     0 LINES WRITTEN
     SECONDARY KEYS RESET TO BLST LLST BSTD LSTD FLSZ
     0 LINES WRITTEN

     PRIMARY KEY SET TO NGDN
     0 LINES WRITTEN
```

```
    PRIMARY KEY SET TO NODE
    SECONDARY KEYS RESET TO NAME X    Y    Z    REFJ EXTJ ANAM NSEC
      TEMP THK  NODP UDAT
  200 LINES WRITTEN
  248 LINES WRITTEN
    SECONDARY KEYS RESET TO NAME ANG1 ANG2 ANG3 PW   PIXX PIYY PIZZ
      PMR
  200 LINES WRITTEN
  247 LINES WRITTEN
    SECONDARY KEYS RESET TO NAME GN01 GN02 GN03 GN04 GN05 GN06 GN07
      GN08 GN09 GN10 GN11 GN12
    0 LINES WRITTEN
    .        .         .         .            .
    .        .         .         .            .

    PRIMARY KEY SET TO EL2D
    SECONDARY KEYS RESET TO NAME CONN THK  TYPE GNUM SUBS OUTC MATL
      TI   TJ   TK   TL
  200 LINES WRITTEN
  202 LINES WRITTEN
    .        .         .         .            .
    .        .         .         .            .
THERE IS NO CURRENT PRIMARY KEY
    THE UIF IS ON FILE 47
    SELECT DESIRED OPTION
         -1 - QUIT (DO NOT SAVE MESH)
          0 - PLOT MESH
          1 - BANDWIDTH REDUCTION
          2 - WRITE UIF
          3 - DEFINE/MODIFY MESH
          4 - GENERATE MESH
         10 - QUIT (SAVE MESH ON RDB)
-1
DATA BASE VERS I.00  04-11-94
    THE COSMO DISK 2D MESH UIF IS part1.2uf
    THE COSMO DISK SHELL UIF IS  part1.suf

    ENTER THE NUMBER OF BLADES AND THE NUMBER OF
    CIRCUMFERENTIAL ELEMENTS TO USE
36 4
    ENTER THE   3 CIRCUMFERENTIAL BIASING PARAMETERS
    ENTER AS PERCENTS, THE SUM BEING LESS THAN 1.0
    ENTER CARRIAGE RETURN FOR EQUAL SPACING
<CR>
    ############################################################
        UNIFIED INPUT FILE (UIF) READER  VERS I.01  05-25-94
    ############################################################
STORAGE    VERS I.01   5-19-94
DATA BASE VERS I.00  04-11-94
READER     VERS I.04  06-02-94

    INPUT FILE HAS BEEN PROCESSED
    YOUR RANDOM DATA BASE IS ON FILE  37
    ############################################################
        SIESTA 2D TO 3D MODEL GENERATOR  VERS I.01  06-23-94
    ############################################################
DATA BASE VERS I.00  04-11-94
    ENTER STRUCTURAL MODEL PROPAGATION OPTION
         (Q) - EXIT FROM 2D TO 3D, (?) - MENU, (INFO) - INFORMATION
         (0)  DO NOT PROPAGATE TEMPERATURES, MATERIAL CODES
         (1)  PROPAGATE TEMPERATURES FROM 2D TO 3D MODEL
         (2)  PROPAGATE MATERIAL CODES FROM 2D TO 3D MODEL
         (3)  PROPAGATE BOUNDARY SURFACES FROM 2D TO 3D MODEL
         (4)  SHIFT PARENT LAYER NODE AND ELEMENT NAMES
         (5)  DISTRIBUTE POINT WEIGHTS OVER THE ROTATED MODEL
2. 3.
```

```
    ENTER GENERATION OPTION
          (Q) - EXIT FROM 2D TO 3D, (?) - MENU, (INFO) - INFORMATION
          (0) ROTATE A 2D MODEL ABOUT AN AXIS
          (1) STACK A 2D MODEL ALONG AN AXIS
          (2) FILL BETWEEN TWO SURFACES
     0
    YOUR MODEL HAS COORDINATES IN ALL THREE AXES.
    ENTER COORDINATE DESCRIPTION OPTION
          (Q) EXIT 2D TO 3D
          (0) THE MODEL IS IN THE YZ PLANE
          (1) THE MODEL IS IN THE XZ PLANE
          (2) THE MODEL IS IN THE XY PLANE
     0
    ENTER DESIRED ROTATION OPTION
          (Q) - EXIT FROM 2D TO 3D, (?) - MENU, (INFO) - INFORMATION
          (0) EQUALLY SPACED ROTATION
          (1) UNEQUALLY SPACED ROTATION
          (INFO) FOR MORE INFORMATION
     0
    ENTER DESIRED SYMMETRY BOUNDARY CONDITION OPTION
          (0) APPLY NO BOUNDARY CONDITIONS
          (1) APPLY SYMMETRIC BOUNDARY CONDITIONS
          (2) APPLY ANTI-SYMMETRIC BOUNDARY CONDITIONS
          (3) APPLY PSEUDO SYMMETRIC BOUNDARY CONDITIONS
     1
    YOU HAVE SELECTED EQUALLY SPACED ROTATION.
    ENTER THE AXIS YOU WISH TO ROTATE ABOUT AS Y OR Z
z
    ENTER THE NUMBER OF ELEMENT LAYERS, THE ANGLE BETWEEN LAYERS,
          THE ANGLE OF THE PARENT LAYER, THE ANGLE OF TWIST,
          THE NODE NAME ADDER, AND THE ELEMENT NAME ADDER
4. 2.5
                  200 NODES PROCESSED
                  400 NODES PROCESSED
                  600 NODES PROCESSED
                  800 NODES PROCESSED
                 1000 NODES PROCESSED
                 1230 NODES PROCESSED
    GENERATING SYMMETRY BOUNDARY CONDITIONS
           0 NODAL ZERO DISPLACEMENTS PROPAGATED
              200 EL2DS PROCESSED INTO      200 BRI8S
              200 EL2DS PROCESSED INTO      400 BRI8S
              200 EL2DS PROCESSED INTO      600 BRI8S
              200 EL2DS PROCESSED INTO      800 BRI8S
    YOUR NEW 3D UIF IS ON FILE 31
    ############################################################
        UNIFIED INPUT FILE (UIF) READER  VERS I.01  05-25-94
    ############################################################
STORAGE   VERS I.01   5-19-94
DATA BASE VERS I.00  04-11-94
READER    VERS I.04  06-02-94

    INPUT FILE HAS BEEN PROCESSED
    YOUR RANDOM DATA BASE IS ON FILE  37

    THE DISK 3D MODEL FILE IS part1.3uf

DATA BASE VERS I.00  04-11-94

    THE 3D DISK MODEL WEIGHT IS     .6288     LB
    THE TOTAL DISK WEIGHT IS        22.64     LB
```

```
     ENTER 1 TO GENERATE A PATRAN NEUTRAL FILE
1
     ############################################################
         SIESTA PATRAN INPUT GENERATOR    VERS I.00  04-11-94
     ############################################################
 DATA BASE VERS I.00  04-11-94
     ENTER THE PATRAN NEUTRAL FILE TITLE (MAX 40 CHARACTERS)
THIS IS A TEST FOR DISKS
     ENTER THE ANALYSIS CODE:
     1-ANSYS  2-NASTRAN  3-SIESTA  4-PTHERMAL  5-UNIGRAPHICS
2
 $
 $   TOTAL DATA BASE CONTENTS
 $            FIRST     LAST      MIN      MAX  NUMBER
 $    NODES       2     1656        1     1675    1230
 $    ELEMS       0        0        1      800     800
 $    BRI8S       1      800        1      800     800
 $
     WRITING PATRAN NEUTRAL FILE
          500 NODES WRITTEN
         1000 NODES WRITTEN
         1230 TOTAL NODES WRITTEN
          492 SETS OF NODAL DISPLACEMENTS WRITTEN
          200 BRI8S WRITTEN
          400 BRI8S WRITTEN
          600 BRI8S WRITTEN
          800 BRI8S WRITTEN
          800 TOTAL BRI8S WRITTEN

     YOUR PATRAN NEUTRAL FILE IS ON FILE  35
     THE COSMO DISK SHELL UIF IS part1.pnf
     ENTER 1 TO GENERATE A CSTEM INPUT FILE
1
     ############################################################
           SIESTA CSTEM DECK GENERATOR  VERS I.00  04-11-94
     ############################################################
 DATA BASE VERS I.00  04-11-94
          TOTAL DATA BASE CONTENTS
         DATA TYPE          MIN      MAX     TOTAL
     ------------------   ------   ------   ------
            NODE               1     1675     1230
            BRI8               1      800      800

     ENTER THE ANALYSIS IDENTIFICATION (UP TO 80 CHAR.)
THIS IS A TEST FOR DISKS
          500 NODES WRITTEN
         1000 NODES WRITTEN
         1230 NODES WRITTEN
          200 8-NODED BRICKS WRITTEN
          400 8-NODED BRICKS WRITTEN
          600 8-NODED BRICKS WRITTEN
          800 8-NODED BRICKS WRITTEN
          492 NODAL ANGLE LINES WERE WRITTEN
          492 NODAL FIXITY LINES WERE WRITTEN
     YOUR CSTEM DECK IS ON FILE 35
     THE MODEL CSTEM INPUT FILE IS part1.cst

          YOU ARE IN THE COSMO GEOMETRY SUB-MENU (1)
     ENTER DESIRED FUNCTION BY NUMBER OR ?,G,Q,SYSTEM
Q

     ###################################################################
       IT IS NOW  2:02 PM ON 06-30-94 WE THANK YOU FOR YOUR PATRONAGE.
     ###################################################################
```

COSMO FUNCTION SUMMARY

FUNCTION:
Print COSMO Menu Structure

SUB-MENU LOCATION:
COSMO Geometry (Sub-Menu 1, Function 4 or **MENU**)

PURPOSE:
This function prints out the current COSMO menu structure showing all sub-menus and functions. The entire COSMO menu structure is written to file 56.

INPUT FILE(S):
NONE

OUTPUT FILE(S):
COSMO menu file (56)

REQUIRED USER INPUT:
At the [MORE] prompt, enter carriage return to continue printing the COSMO menu or enter "Q" to stop printing the COSMO menu to the terminal.

COMMENTS:
NONE

FUNCTION VERSION INFORMATION:
NONE

COSMO FUNCTION SUMMARY

FUNCTION:
COSMO News Function

SUB-MENU LOCATION:
COSMO Geometry (Sub-Menu 1, Function 5 or **NEWS**)

PURPOSE:
This function prints out the COSMO Driver Message, Phone List, and NEWS.

INPUT FILE(S):
NONE

OUTPUT FILE(S):
NONE

REQUIRED USER INPUT:
You must select the message that you want printed to the screen.

COMMENTS:

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.00 06-94 will not be reflected in this release of the manual.

1.6.1.5.1. FUNCTION DESCRIPTION

This function permits you to view the COSMO News messages. Currently there are five News function options. The options are:

1) COSMO Driver Message
2) COSMO Phone List
4) COSMO News Messages

Any or all of the messages can be printed to the screen by entering the option numbers. The News Messages are written in chronological order starting with the most recent message. The News messages will be updated to tell the users of any new functions or enhancements to current functions. The Driver message will contain the date of the last News message update. Enter Q or QUIT to exit the NEWS function.

COSMO FUNCTION SUMMARY

FUNCTION:

Create SIESTA Random Data Base (RDB) from Unified Input File (UIF)

SUB-MENU LOCATION:

SIESTA Functions (Sub-Menu 2, Function 1 or **UIFREAD**)

PURPOSE:

This function reads a Unified Input File (UIF), checks the syntax, and writes a Random Data Base (RDB).

INPUT FILE(S):

Unified Input File (31)

OUTPUT FILE(S):

RDB (37)

REQUIRED USER INPUT:

None unless terminal input is requested in the UIF or certain error conditions are encountered.

COMMENTS:

The default values of maximum node and element name are 20480. The default values of maximum master node and master region name are 4096. The default values of maximum geometry node and geometry entity name are 10240. These may be reset as described in this description.

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.01 05-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:
Random Data Base Outline Generator

SUB-MENU LOCATION:
SIESTA Functions (Sub-Menu 2, Function 2 or **OUTLINE**)

PURPOSE:
This function determines the free edges and connected outlines of regions in the Random Data Base (RDB) comprised of EL2D, PE2D or HT2D elements and stores this information on the RDB. This permits you to check for "cracks" or "holes" in a discretized area by plotting this outline and to assign boundary conditions using the outline. In addition, this function can be used to tag "boundary surfaces" for boundary condition application.

INPUT FILE(S):
RDB (37)

OUTPUT FILE(S):
The RDB is updated to contain free edge and outline information, and, optionally, boundary surfaces.

REQUIRED USER INPUT:
None for outline only. User input may be required to define boundary surfaces.

COMMENTS:
NONE

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.00 04-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:

Random Data Base Surface Generator

SUB-MENU LOCATION:

SIESTA Functions (Sub-Menu 2, Function 3 or **SURFACE**)

PURPOSE:

The function identifies the free surfaces and free edges of all 3D solid elements (BRI8, VANS, and HT3D) and writes this information to the Random Data Base (RDB) . In addition, this function can be used to tag "boundary surfaces" for boundary condition application. You must run this function prior to making hidden-line or free-edge plots via the SIESTA Graphics function (Sub-Menu 2, Function 6 or **GRAPHICS**).

INPUT FILE(S):

RDB (37)

OUTPUT FILE(S):

The RDB is updated to contain the free-edge and surface information, and, optionally, boundary surfaces.

REQUIRED USER INPUT:

If you choose to tag boundary surfaces, additional input may be needed to identify the desired surfaces.

COMMENTS:

NONE

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.00 04-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:

Edit Random Data Base

SUB-MENU LOCATION:

SIESTA Functions (Sub-Menu 2, Function 4 or **EDIT**)

PURPOSE:

This function permits you to modify an existing Random Data Base (RDB) with data on an auxiliary UIF. You may add additional information or modify (overwrite) current data.

INPUT FILE(S):

RDB (37)
UIF containing change information. (32)

OUTPUT FILE(S):

The RDB is modified to reflect the changes.

REQUIRED USER INPUT:

None, unless you have specified terminal input. Certain error conditions may request input from the terminal.

COMMENTS:

New material definitions may be added; however, current material data may not be altered.

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.01 05-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:
NASTRAN Deck Generator

SUB-MENU LOCATION:
SIESTA Functions (Sub-Menu 2, Function 5 or **NASTRAN**)

PURPOSE:
This function creates a NASTRAN Bulk Data Deck from a Random Data Base (RDB).

INPUT FILE(S):
RDB (37)

OUTPUT FILE(S):
NASTRAN bulk data deck (35)

REQUIRED USER INPUT:
NONE

COMMENTS:
NONE

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.00 04-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:

SIESTA Graphics

SUB-MENU LOCATION:

SIESTA Functions (Sub-Menu 2, Function 6 or **GRAPHICS**)

PURPOSE:

This function generates plots from a Random Data Base (RDB) . Various labelling options as well as hidden line, free edge, displaced and contour plots are available. Copies of the plots may be directed to plotters.

INPUT FILE(S):

RDB (37)

OUTPUT FILE(S):

PLOT FILE (36)

REQUIRED USER INPUT:

The plot specifications must be entered interactively.

COMMENTS:

On-line help is available. Window information may be saved for use other functions (e.g. RDB Extract function.)

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.05 06-94 will not be reflected in this release of the manual.

SIESTA FUNCTION SUMMARY

FUNCTION:
SIESTA 2D Plotting

SUB-MENU LOCATION:
SIESTA Functions (Sub-Menu 2, Function 7 or **PLOT**)

PURPOSE:
This routine generates plots from a Unified Plot File (UPF) . Copies of the plots may be directed to Postscript plotters.

INPUT FILE(S):
UPF (51)

OUTPUT FILE(S):
Postscript plot file (36)

REQUIRED USER INPUT:
The plot specifications may be entered interactively

COMMENTS:
On-line help is available

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.02 06-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:

Translate Random Data Base (RDB) to Unified Input File (UIF)

SUB-MENU LOCATION:

SIESTA Functions (Sub-Menu 2, Function 8 or UIFWRITE)

PURPOSE:

This function reads data from a RDB and writes a UIF. Nodes and elements may be renamed before they are written to the UIF.

INPUT FILE(S):

RDB (37)

OUTPUT FILE(S):

Initial UIF (47)
Subsequent UIFs using the NEWF command (56 thru 60)

REQUIRED USER INPUT:

You must specify which data to retrieve. You may also rename items on the output UIF.

COMMENTS:

This function can selectively retrieve:
1) All RDB input data
2) Geometric data
3) Boundary Condition data
4) Specific input data defined by primary and secondary keys

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.02 06-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:
Translate a Patran Neutral File to a Unified Input File (UIF).

SUB-MENU LOCATION:
SIESTA Functions (Sub-Menu 2, Function 9 or **UF4**)

PURPOSE:
This function reads a PATRAN Neutral File and generates an equivalent UIF.

INPUT FILE(S):
PATRAN Neutral File

OUTPUT FILE(S):
UIF (31)

REQUIRED USER INPUT:
(1) The PATRAN Neutral File name.
(2) The analysis code corresponding to the PATRAN Neutral File.
(3) Whether the model should be flipped from the default PATRAN plane (XY) to the SIESTA plane (YZ) (for 2D).

COMMENTS:
Not all PATRAN data packet types are translated. Element property data cannot be processed if there is a discrepancy between the configuration number and analysis code entered.

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.00 04-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:

Master Region Mesh Generator (MR.MESH)

SUB-MENU LOCATION:

SIESTA Functions (Sub-Menu 2, Function 10 or **MESH**)

PURPOSE:

This function generates a mesh of quadrilateral, triangular, or shell elements from a Random Data Base (RDB) containing master regions. This function will write a Unified Input File (UIF) with the mesh information, save the mesh information in the RDB, or both. Rigid conectors between axisymmetric shell elements and quadrilaterals are automatically generated. You may interactively modify the mesh, plot the model, or perform bandwidth reduction in this function.

INPUT FILE(S):

Random Data Base (37) containing master regions

OUTPUT FILE(S):

UIF (31) (on request)
RDB (37) (on request)

REQUIRED USER INPUT:

You must enter mesh definition information, if there is not enough information on the RDB to completely define the mesh.

COMMENTS:

The input RDB cannot contain any nodes or elements.

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.01 05-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:

2D to 3D Model Generation

SUB-MENU LOCATION:

SIESTA Functions (Sub-Menu 2, Function 11 or **TO3D**)

PURPOSE:

The purpose of this function is to generate a 3D UIF from 2D data on a Random Data Base (RDB). The 3D model may be generated by stacking along an axis, rotating about an axis, or filling between two planes.

INPUT FILE(S):

RDB (37)

OUTPUT FILE(S):

UIF (31)
Errors or warning messages (30)

REQUIRED USER INPUT:

You must specify the method for generating the 3D model (stack, rotate, fill), the number of element layers, and the spacing of the layers.

COMMENTS:

On-line information is available at any menu level.
This function currently supports these elements type conversions:

SHEL to PLAT
RING to BEAM
(2D) RIGI to (3D) RIGI
EL2D to BRI8
HT2D to HT3D
PE2D to VANS

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.01 06-94 will not be reflected in this release of the manual.

SIESTA FUNCTION SUMMARY

FUNCTION:
Bandwidth Optimizer (Gibbs-Poole-Stockmeyer Routine)

SUB-MENU LOCATION:
SIESTA Functions (Sub-Menu 2, Function 12 or **BAND**)

PURPOSE:
This routine attempts to reduce the nodal bandwidth of the data on a Random Data Base (RDB) using the GPS algorithm.

INPUT FILE(S):
RDB (37)

OUTPUT FILE(S):
The RDB may be modified to reflect the new node ordering.

REQUIRED USER INPUT:
After the banding routine is complete, you may reorder the RDB.

COMMENTS:
A new UIF, reflecting the new node ordering, may be written with the RDB to UIF function (Sub-Menu 2, Function 8 or **UIFWRITE**)

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.00 04-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:
Convert Random Data Base to an IGES Geometry File

SUB-MENU LOCATION:
SIESTA Functions (Sub-Menu 2, Function 13 or **GEOM**)

PURPOSE:
This function writes geometry information on a Random Data Base (RDB) to a IGES geometry file.

INPUT FILE(S):
RDB (37)

OUTPUT FILE(S):
IGES file (40)

REQUIRED USER INPUT:
The user must select the type of data to write to the IGES file and also input the identification data that IGES files require.

COMMENTS:
NONE

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.01 05-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:
Translate RDB to PATRAN Neutral File

SUB-MENU LOCATION:
SIESTA Functions (Sub-Menu 2, Function 14 or **PATRAN**)

PURPOSE:
This function creates an PATRAN Neutral File from a Random Data Base (RDB).

INPUT FILE(S):
RDB (37)

OUTPUT FILE(S):
PATRAN Neutral File (35)

REQUIRED USER INPUT:
An analysis title is requested. The analysis code type is requested. Node and element adders are requested. 2D models may be flipped from the SIESTA Y-Z plane to the PATRAN X-Y plane.

COMMENTS:
Not all options and all element types are currently supported. See the function description for details.

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.00 04-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:

Airfoil Mesh Generator

SUB-MENU LOCATION:

SIESTA Functions (Sub-Menu 2, Function 15 or **AIRFOIL**)

PURPOSE:

This function generates plate, brick or variable-noded solid element meshes from an aero coordinate definition. The output is a Unified Input File (UIF)

INPUT FILE(S):

Aero Geometry file (40)

OUTPUT FILE(S):

UIF (31)
Airfoil Paired Node UIF (32)

REQUIRED USER INPUT:

The chordwise, spanwise, and thickness mesh densities must also be specified as well as the element type to be generated

COMMENTS:

This function is particularly useful for the generation of 3D solid airfoils. (Fan and compressor vanes and blades). It also can be used to generate plate models of hollow stiffened struts

FUNCTION VERSION INFORMATION:

Any changes made to this function after version I.00 04-94 will not be reflected in this release of the manual.

COSMO FUNCTION SUMMARY

FUNCTION:
CSTEM Deck Generator

SUB-MENU LOCATION:
SIESTA Functions (Sub-Menu 2, Function 16 or **CP4**)

PURPOSE:
This function creates an input file for the CSTEM finite element analysis program from a Random Data Base (RDB).

INPUT FILE(S):
RDB (37)
CSTEM layer specification file (51)

OUTPUT FILE(S):
CSTEM deck (35)

REQUIRED USER INPUT:
The user must specify the IDNT data (either direct input or to approve using the ANLS CSTI data). Also for element layering, the user must specify the boundary surfaces to generate cross sections for.

COMMENTS:
Only CSTEM structural analysis is supported by this function.

FUNCTION VERSION INFORMATION:
Any changes made to this function after version I.00 04-94 will not be reflected in this release of the manual.

REPORT DOCUMENTATION PAGE

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13. ABSTRACT ***(Maximum 200 words)***

A component specific modeling software program has been developed for propulsion systems. This expert program is capable of formulating the component geometry as finite element meshes for structural analysis, in the future, can be spun off as NURB geometry for manufacturing. COSMO currently has geometry recipes for combustors, turbine blades, vanes, and disks. Component geometry recipes for nozzles, inlets, frames, shafts and ducts are being added. COSMO uses component recipes that work through neutral files with the Technology Benefit Estimator (T/BEST) program which provides the necessary base parameters and loadings (E.R. Generazio and C.C. Chamis, "Technology Benefit Estimator for Aerospace Propulsion Systems", AIAA-94-3096, June 1994). This report contains the users manual for combustors, turbine blades, vanes, and disks.

14. SUBJECT TERMS

Structural analysis; Propulsion; Jet engines; Components modeling; Thermal analysis; Finite element; Creep; Plasticity; Nozzles; Turbine; Fan; Compression; Combustor; Inlet; Blades; Vanes; Ducts

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