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High Temperature Composite Analyzer (HITCAN) Demonstration Manual

Version 1.0

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(NASA-TM-106003) HIGH TEMPERATURE
COMPOSITE ANALYZER (HITCAN)
DEMONSTRATION MANUAL, VERSION 1.0
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April 1993

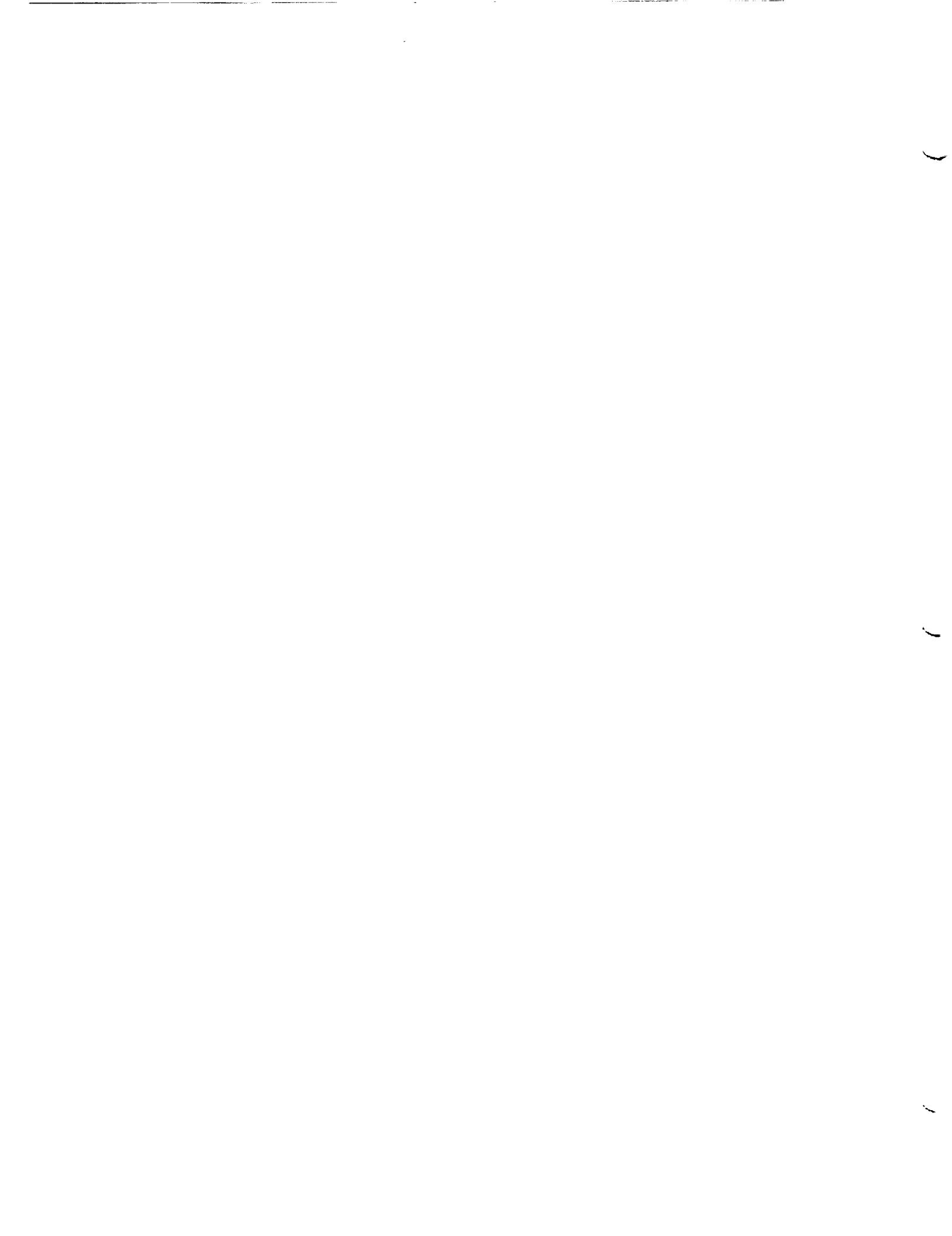
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TABLE OF CONTENTS

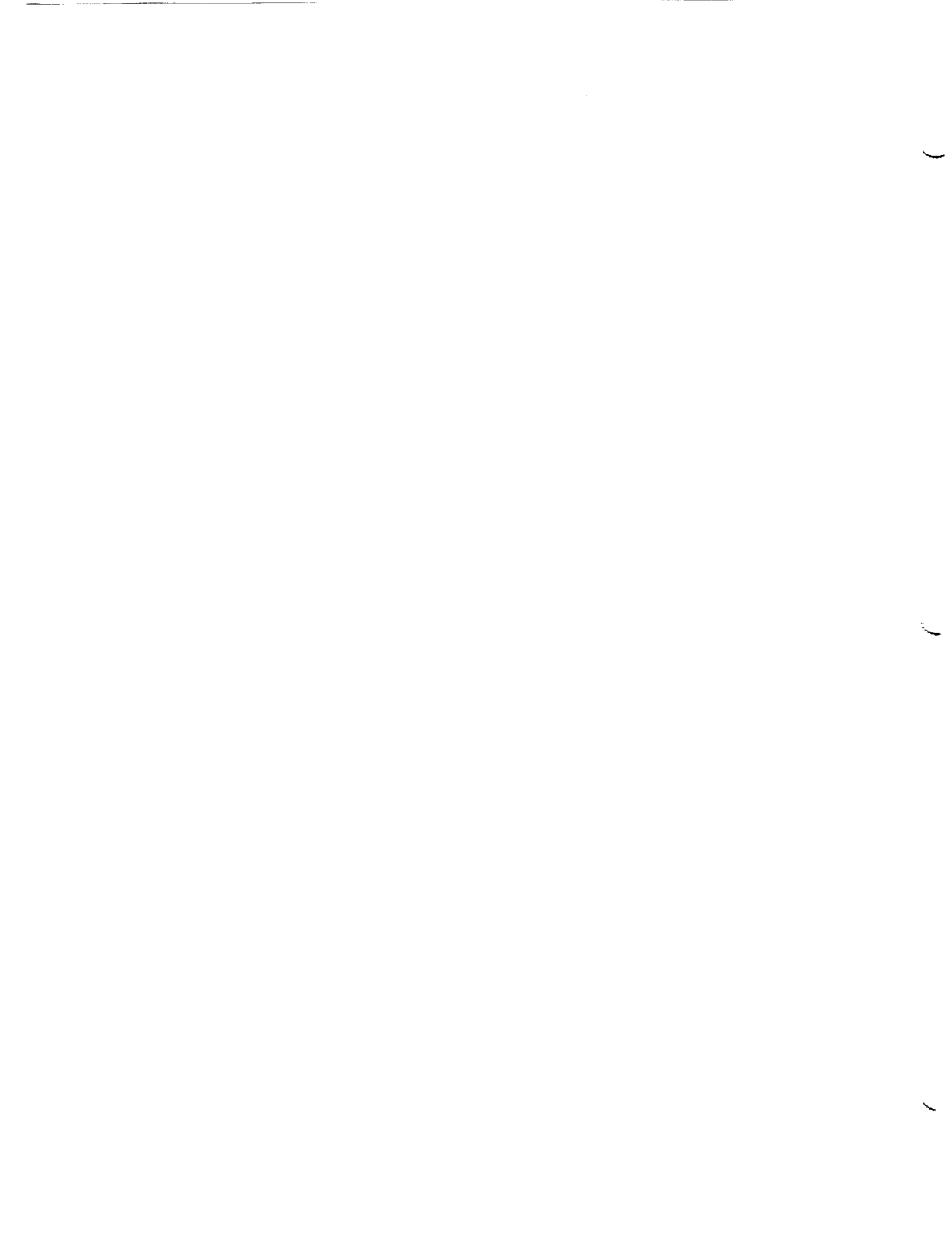
	<u>Page</u>
ABSTRACT	ABST1
1. INTRODUCTION	INTRO1
2. BRIEF DESCRIPTION OF HITCAN	BRIEF1
3. LIST OF DEMONSTRATION PROBLEMS	LIST1
4. DEMONSTRATION PROBLEMS	
PROBLEM #1	DEMO12
PROBLEM #2	DEMO21
PROBLEM #3	DEMO31
PROBLEM #4	DEMO41
PROBLEM #5	DEMO51
PROBLEM #6	DEMO61
PROBLEM #7	DEMO71
PROBLEM #8	DEMO81
PROBLEM #9	DEMO91
PROBLEM #10	DEMO101
PROBLEM #11	DEMO111
PROBLEM #12	DEMO121
PROBLEM #13	DEMO131
REFERENCES	REF1



ABSTRACT

This manual comprises a variety of demonstration cases for the HITCAN (High Temperature Composite ANalyzer) code. HITCAN is a general purpose computer program for predicting nonlinear global structural and local stress-strain response of arbitrarily oriented, multilayered high temperature metal matrix composite structures. HITCAN is written in FORTRAN 77 computer language and has been configured and executed on the NASA Lewis Research Center CRAY XMP and YMP computers. Detailed description of all program variables and terms used in this manual may be found in the USER's MANUAL.

The demonstration manual includes various cases to illustrate the features and analysis capabilities of the HITCAN computer code. These cases include: 1) static analysis, 2) nonlinear quasi-static (incremental) analysis, 3) modal analysis, 4) buckling analysis, 5) fiber degradation effects, 6) fabrication-induced stresses for a variety of structures; namely, beam, plate, ring, shell, and built-up structures. A brief discussion of each demonstration case with the associated input data file is provided. Sample results taken from the actual computer output are also included.



CHAPTER 1

INTRODUCTION

This manual presents input data files for 13 sample problems demonstrating the static, buckling, modal, and quasi-static analysis capabilities of the high temperature composite analyzer code HITCAN. The quasi-static analysis means incremental nonlinear analysis where the material properties are updated at the end of each load step, based on a nonlinear multi-factor interaction model (Ref. 1). With continued enhancements, HITCAN is expected to be capable of handling a wide spectrum of analyses for high temperature metal matrix composite structures, all of which are not demonstrated in the present edition of this manual. Table I lists capabilities of HITCAN, showing the ones that have been demonstrated (Ref. 2) marked 'tested' in italic typeface. Each analysis capability is demonstrated for five generic types of structures, i.e. beam, plate, ring, curved panel, and a built-up structure. The sample problems include special code features such as fiber degradation and fabrication-induced stresses.

HITCAN can model structural components with solid as well as hollow geometrical shapes. The input data structure is different for solid versus hollow structures. All beam, plate, ring, and curved panel problems demonstrate modeling of solid structures and those for built-up structure demonstrate modeling of hollow structures.

The element library in the current version 1.0 of HITCAN includes plate, 3D solid, plane stress, and plane strain elements. The finite element code, MHOST, utilized in HITCAN also includes beam and axisymmetric elements. Further, MHOST is presently being updated to allow mixing of elements. All of these individual and mixed element capabilities will become functional in HITCAN in the future. The 13 problems presented in the present edition of this manual were modeled using the plate element. Demonstration problems for other element types of HITCAN will be added as they become available.

Although an effort is made to include all the information necessary for understanding the demonstration problems in the present manual, a line-by-line description of the input files is not provided. It is expected that the user has access to the HITCAN User's Manual (Ref. 3). The user's manual includes 2 sample problems with detailed explanation of input and output data structures.

The description of demonstration problems is provided in numerical order from 1 to 13. Figures showing geometry, boundary conditions, and loading, files showing the data structure, and a file showing selected portions of the output data structure are included with each problem. The detailed output files have been archived in NASA's VM computer system and can be retrieved, if necessary. The material property data files being similar for many problems, are given in Appendix 1. The HITCAN execution command files ("DEMOX NQS" and "DEMOY NQS" for the NASA LeRC CRAY XMP and YMP computers, respectively) are included in Appendix 2.

Table 1. - HITCAN Capabilities for Composite Materials

Type of Analysis	Type of Structure	Beam	Plate	Ring	Curved Panel	Built-up Structure
Static		tested	tested	tested	tested	tested
Buckling (a)		tested	tested	tested	tested	tested
Load Stepping		tested	tested	tested	tested	tested
Modal (Natural Vibration Modes) (b)		tested	tested	tested	tested	tested
Time-domain		-	-	-	-	-
Loading						
Mechanical		tested	tested	tested	tested	tested
Thermal		tested	tested	tested	tested	tested
Cyclic		-	-	-	-	-
Impact		-	-	-	-	-
Constitutive Models (c)						
P = Constant		tested	tested	tested	tested	tested
P = f(T)	(temperature dependence)	tested	tested	tested	tested	tested
P = f(σ)	(stress dependence)	tested	tested	tested	tested	tested
P = f($\dot{\sigma}$)	(stress rate dependence)	tested	tested	tested	tested	tested
P = f(t)	(creep)	-	-	-	-	-
P = f(T, $\dot{\sigma}$, σ)	(combination)	tested	tested	tested	tested	tested
P = f(T, $\dot{\sigma}$, σ , t)	(creep combination)	-	-	-	-	-
Fiber Degradation		tested	tested	tested	tested	tested
Fabrication-Induced Stresses		tested	tested	tested	tested	tested
Ply Orientations (d)						
Arbitrary		tested	tested	tested	tested	tested

(a) Tested 1 buckling mode
 (b) Tested 4 vibration modes
 (c) Constitutive models: Notation
 P: Material Properties
 T: Temperature
 (d) Tested 3 ply orientations:
 Unsymmetric: (0/ + 45/90)
 Symmetric: (0/45)_s
 Blanced: (0/90)_s
 σ : Stress
 $\dot{\sigma}$: Stress rate
 t: Time

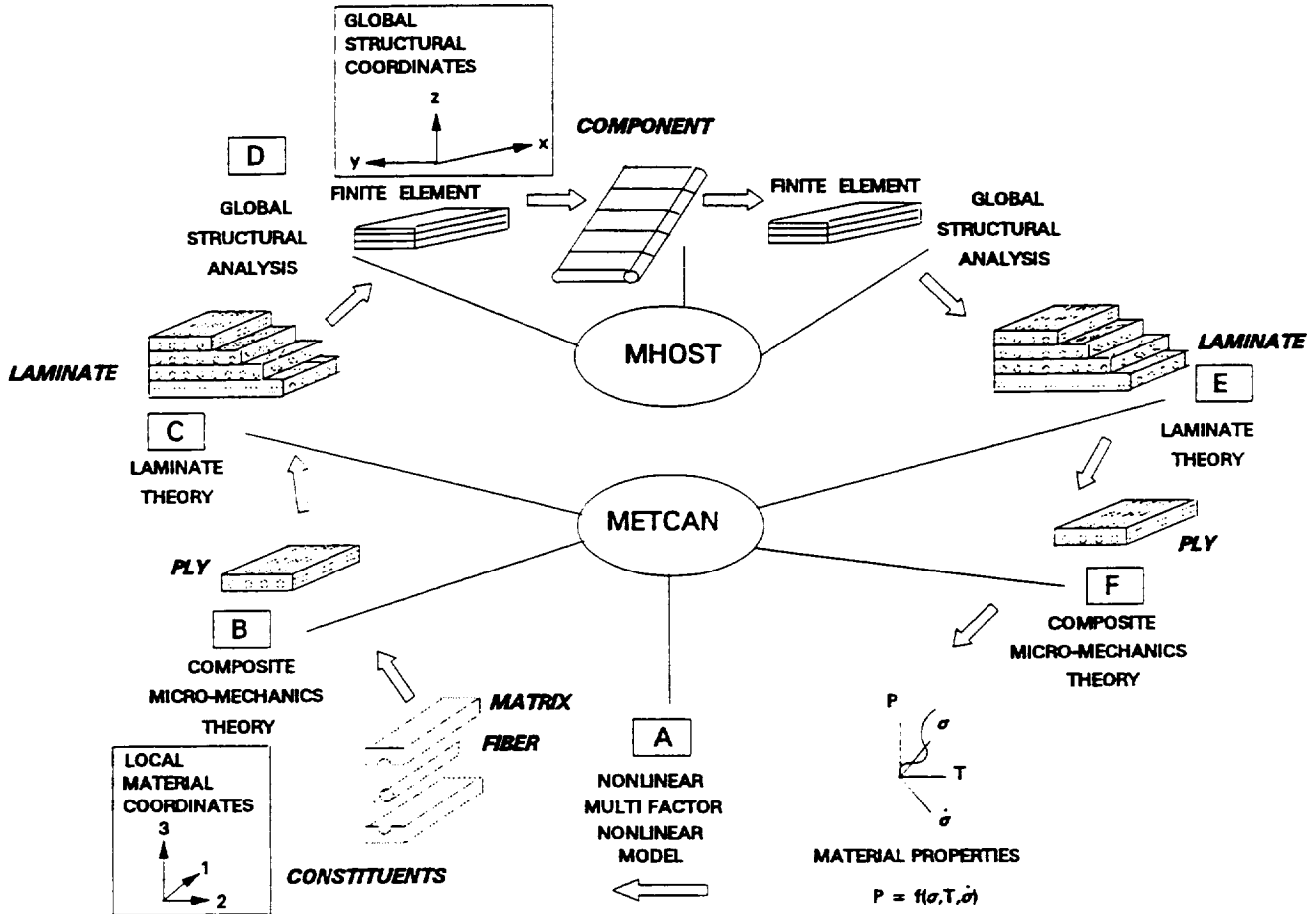
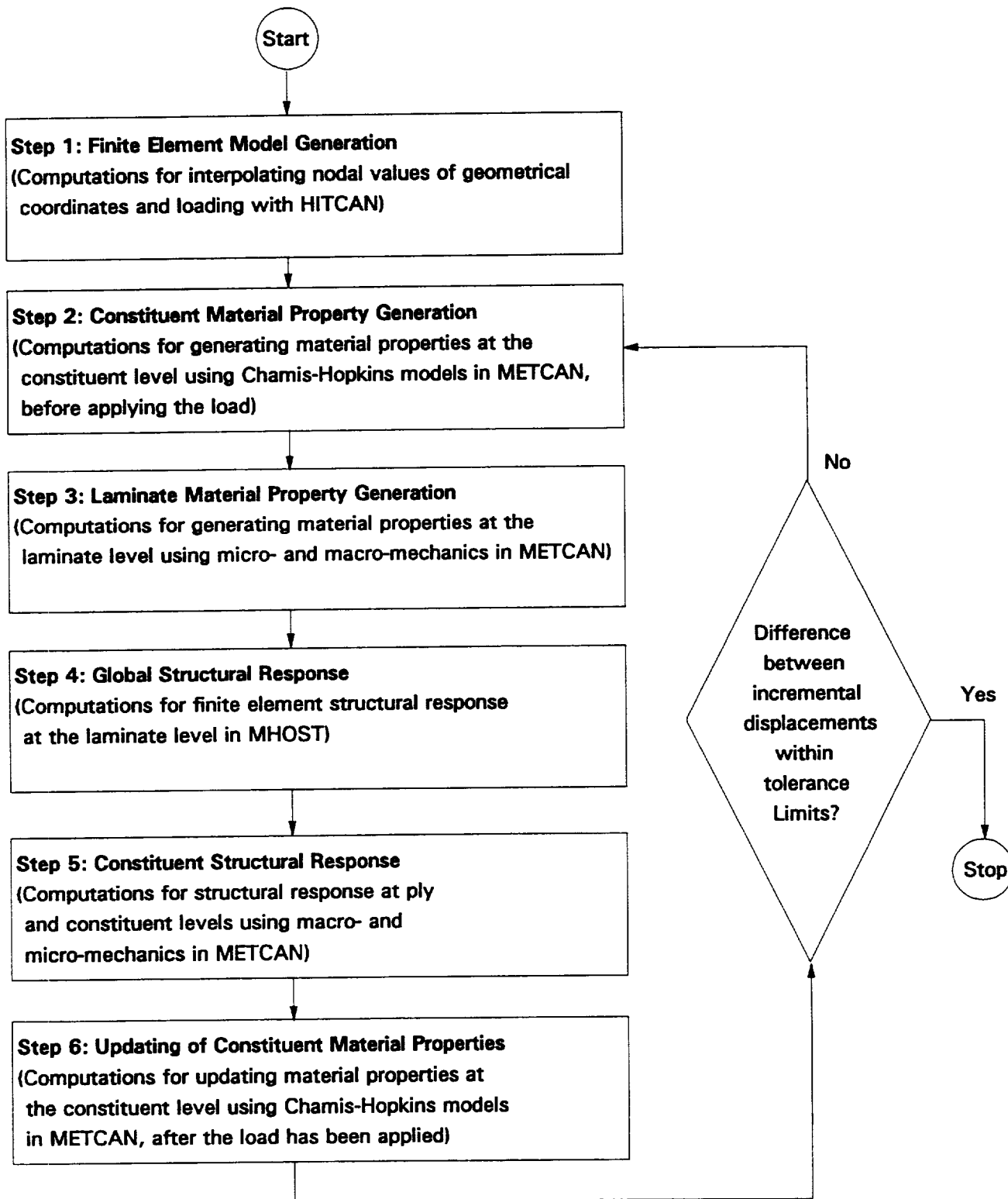


Figure 1 - HITCAN: An Integrated Approach for High Temperature Composite Structural Analysis

HITCAN Demonstration Manual - Version I.0



Chapter 2

Figure 3 - Flow Chart for HITCAN Computational Procedure

March, 1992

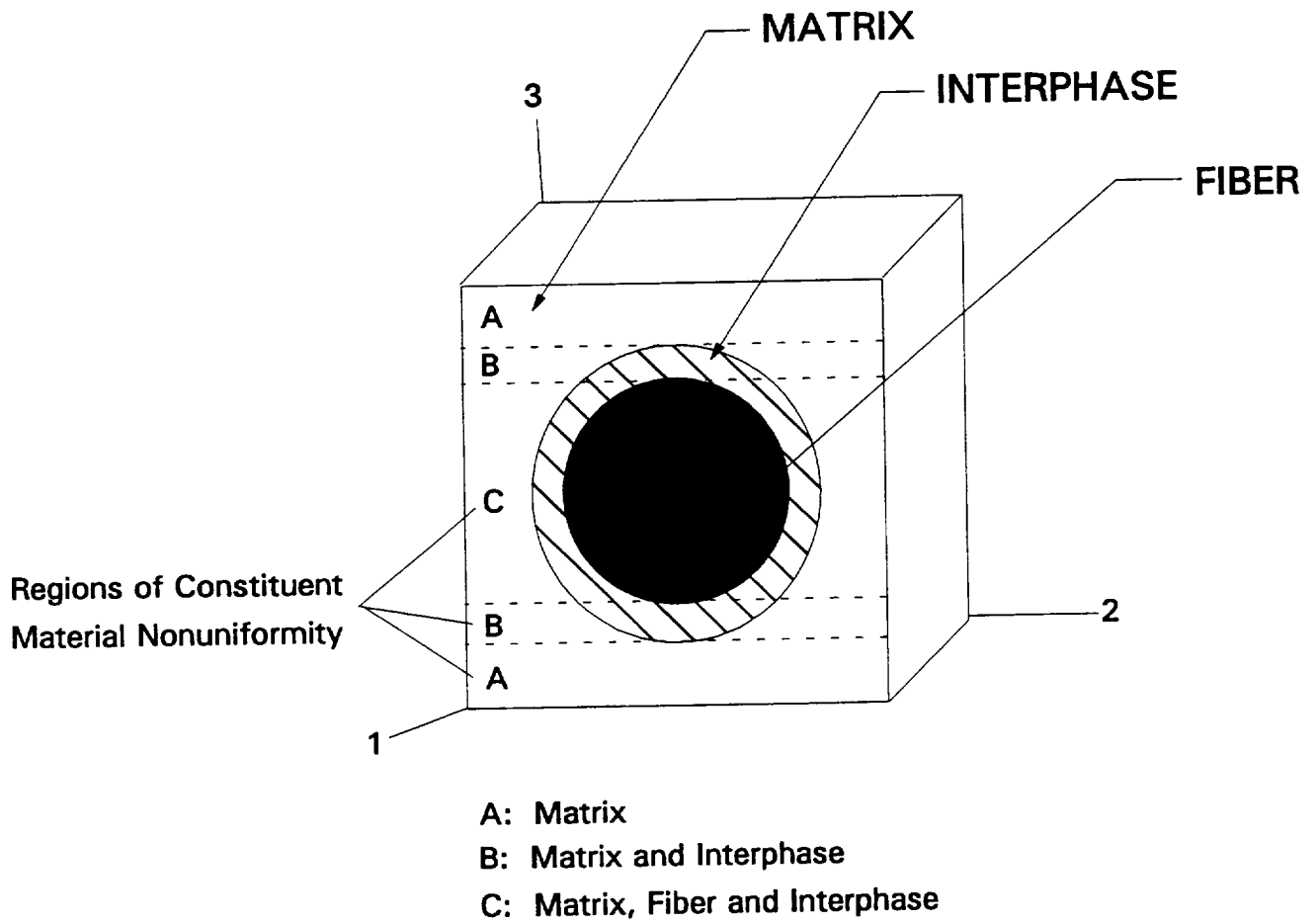


Figure 2 - Schematics for Regions of Constituent Material Nonuniformity

CHAPTER 2

BRIEF DESCRIPTION OF HITCAN

HITCAN presents a synergistic combination of NASA-developed codes: COBSTRAN (Ref. 4), METCAN (Ref. 5), and MHOST (Ref. 6). COBSTRAN provided the finite element mesh generation capability which was enhanced to include new features such as modeling of curved surfaces. METCAN serves 3 important functions: (1) it computes material properties at ply and laminate levels from the user-input properties of composites at the constituent (fiber, matrix, and interphase) level using a nonlinear multi-factor interaction model; (2) it computes stress response at the ply and constituent levels from the MHOST-calculated stress response at the laminate level; (3) it updates the material properties at all levels of the composite structure based on user-selected input/output parameters such as time, temperature loading, and output stresses at each step of the loading increment. MHOST is used to perform the finite element analysis at laminate level.

Figure 1 summarizes the integrated METCAN/MHOST approach. The different regions of constituent materials are shown in Figure 2. The flow chart for the computational procedure used in HITCAN is depicted in Figure 3.

HITCAN can be executed with the minimum information for the characterization of arbitrarily oriented, multilayered composites. The user needs to input the material properties at the most basic level of the composite i.e., the constituents. The code does the rest. To make it even more friendly to use, HITCAN includes a material property database for typical aerospace fiber and matrix materials. The user needs to specify only a code name of the material (rather than having to input all the properties) in the HITCAN input. HITCAN automatically searches, selects, and updates the appropriate properties from its database. The database includes graphite, boron, silicon carbide, and tungsten fibers, and aluminum, titanium, copper, magnesium, and beryllium matrix materials.

HITCAN is continually enhanced as more research bears fruit. It has, however, already been developed and tested for many features qualifying it as a useful design tool for a variety of structures for which HITCAN has been/is being demonstrated.

HITCAN is modular, open-ended, and user-friendly. It includes special features such as fiber degradation effect and fabrication-induced stresses. Because of the multi-level analysis approach, HITCAN offers the utility for studying the influence of individual constituent in-situ behavior of global structural response. These features make HITCAN a powerful, cost-effective tool for analyzing/designing metal matrix composite structures and components.

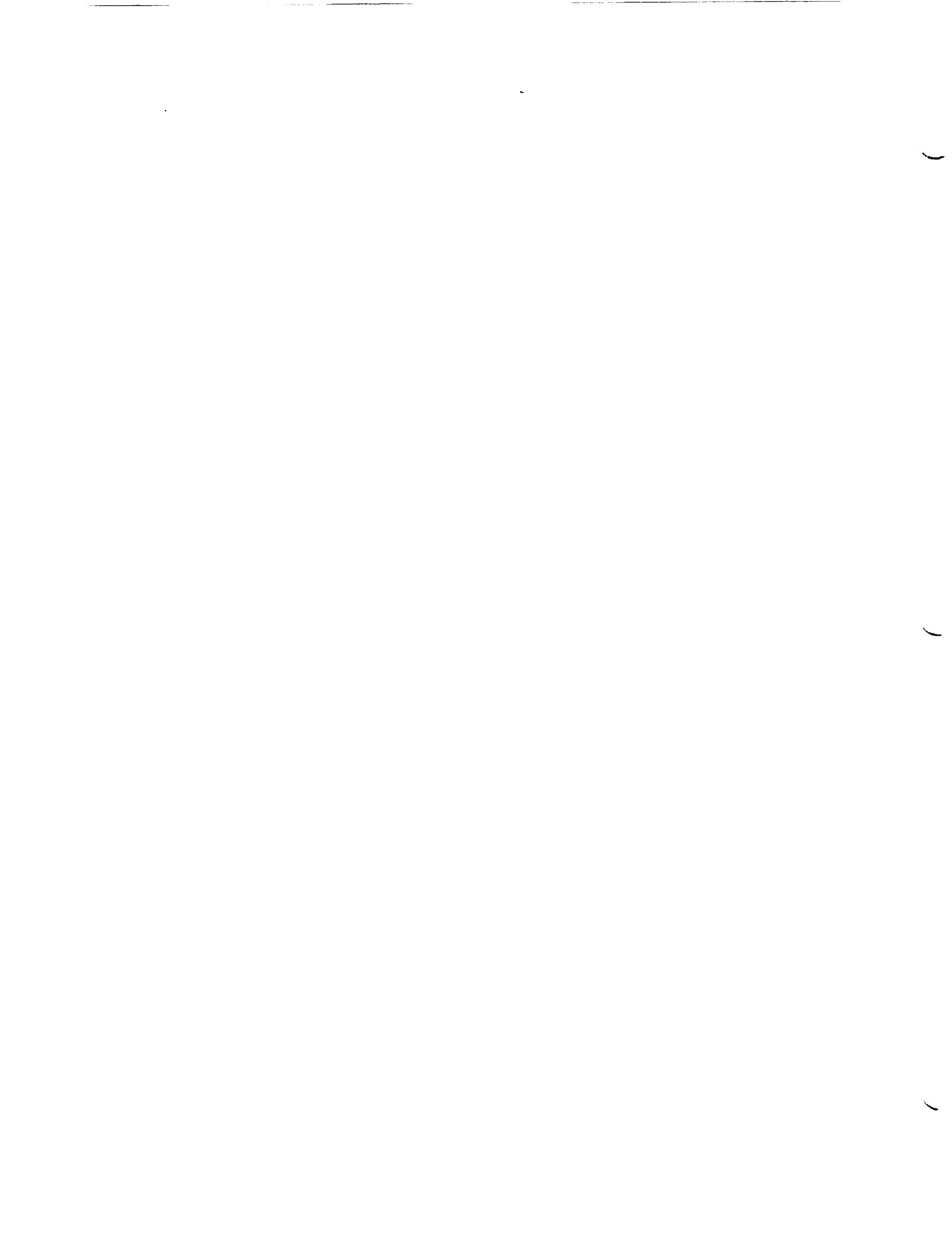
HITCAN Demonstration Manual - Version I.0

CHAPTER 3

LIST OF DEMONSTRATION PROBLEMS

A list of features demonstrated in all 13 sample problems included in the present version of the manual, is provided below.

Problem #	Type of Analysis	Type of Structure	Loading		Boundary Conditions	Additional Features	Page #
			Thermal	Mechanical			
1	Static	Beam	Uniform Heating	Concentrated Load	Cantilever	----	DEMO11
2	Static	Plate	Uniform Heating	Concentrated Load	Simply Supported	----	DEMO21
3	Static	Ring	Uniform Heating	Concentrated Load	Cantilever	----	DEMO31
4	Static	Curved Panel	Uniform Heating	External Pressure	Fixed-Free	----	DEMO41
5	Static	Built-up Structure	Uniform Heating	Internal Pressure	Bottom Supported	----	DEMO51
6	Buckling	Curved Panel	----	External Pressure	Fixed-Free	----	DEMO61
7	Buckling	Built-up Structure	----	Distributed Load	Simply Supported-Free	----	DEMO71
8	Buckling	Curved Panel	----	External Pressure	Fixed-Free	Fiber Degradation	DEMO81
9	Buckling	Built-up Structure	----	Distributed Load	Simply Supported-Free	Fiber Degradation	DEMO91
10	Load Stepping & Modal	Curved Panel	Uniform Heating	External Pressure	Fixed-Free	----	DEMO101
11	Load Stepping & Modal	Built-up Structure	Uniform Heating	Internal Pressure	Bottom Supported	----	DEMO111
12	Load Stepping	Curved Panel	Uniform Heating	External Pressure	Fixed-Free	Fabrication-Induced Stresses	DEMO121
13	Load Stepping	Built-up Structure	Uniform Heating	Internal Pressure	Bottom Supported	Fabrication-Induced Stresses	DEMO131



HITCAN Demonstration Manual - Version I.0

Table II. - Constituent Material Properties At Unstressed Reference Temperature (70 °F) State

<u>SiC Fiber</u>		<u>Ti-15-3-3-3 Matrix</u>	
P_f	0.11 lb/in ³	P_m	0.172 lb/in ³
E_f	62 Mpsi	E_m	12.3 Mpsi
μ_f	0.3 in/in	μ_m	0.32 in/in
G_f	23.8 Mpsi	G_m	4.7 Mpsi
α_f	1.8 ppm	α_m	4.5 ppm
T_{Mf}	4870 °F	T_{Mm}	1800 °F
S_{11T}	500 ksi	S_{mT}	130 ksi
S_{11C}	650 ksi	S_{mC}	130 ksi
S_{22T}	500 ksi	S_{mS}	91 ksi
S_{22C}	650 ksi		
S_{12S}	300 ksi		
D_f	5.6 mils		

Notation:

D: Fiber Diameter
E: Elastic Modulus
G: Shear Modulus
S: Strength
T: Temperature
P: Density
 μ : Poisson's Ratio
 α : Coefficient of Thermal Expansion

Subscripts:

c: Compression
f: Fiber
m: Melting
m: Matrix
s: Shear
T: Tension
11: Direction 11
22: Direction 22
12: Direction 12

CHAPTER 4

DEMONSTRATION PROBLEM NO. 1

PROBLEM TYPE:

Static analysis of a solid beam type structure using plate element subjected to thermo-mechanical loading.

PROBLEM DESCRIPTION:

A cantilever beam of 2" length and 0.5 x 0.125 " cross-section is subjected to a concentrated load of 100 lb at the center of free end and a uniform temperature increase from 70 to 1000 F. The beam is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (0/45/-45/90) plies of equal thickness with 0.4 fiber volume ratio. The ply lay-up is such that the 0 degree ply is at the top and the 90 degree at the bottom of the beam. The material properties at the reference temperature of 70 F are listed in Table II. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

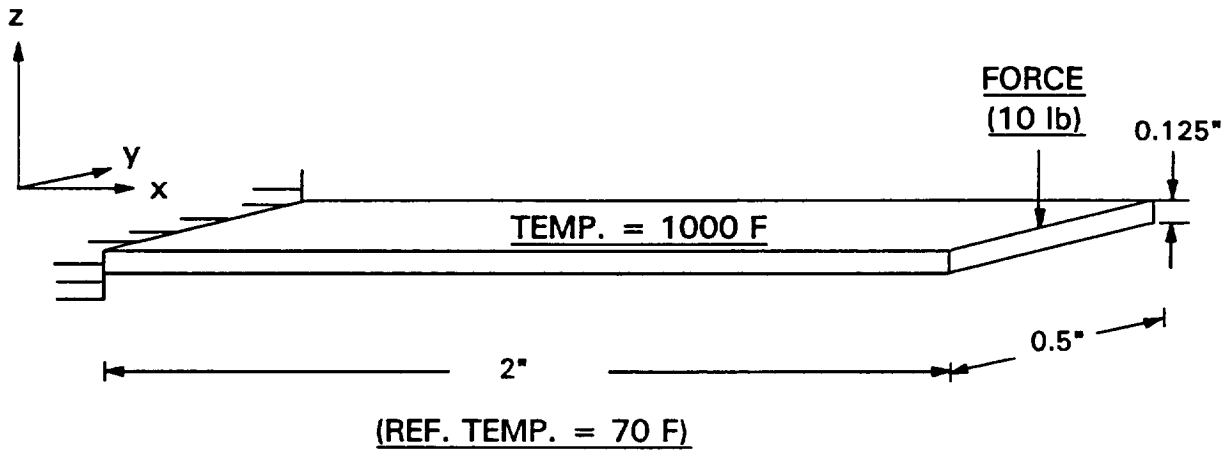
MODELING HINTS:

The finite element mesh consists of 12 elements in x-direction and 4 in y-direction (IU = 13 and JU = 5 on card group # 3). The material property data file, "DATAS BANK" is included in Appendix 1.

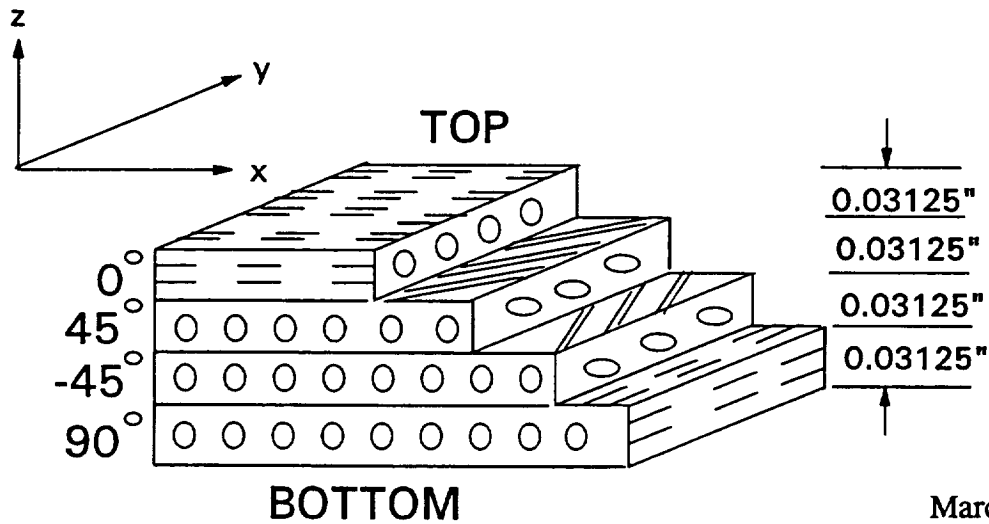
PROBLEM # 1

**CANTILEVER BEAM UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING

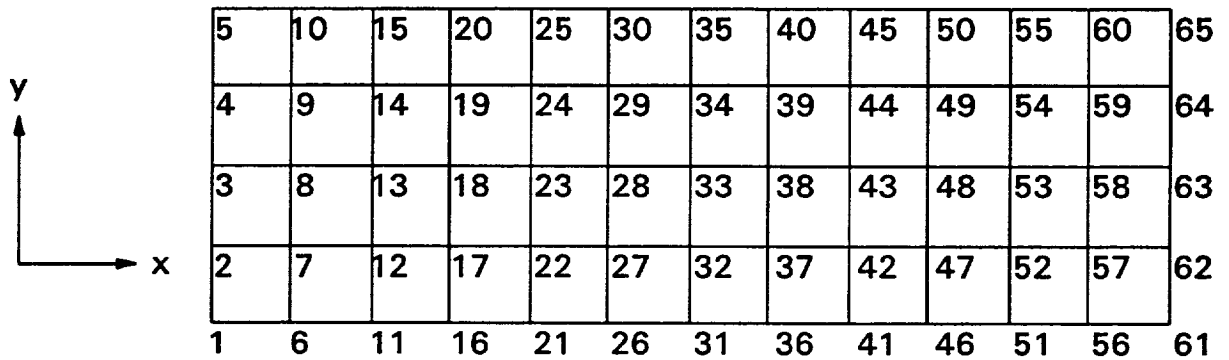


PLY LAY-UP IN Z-DIRECTION

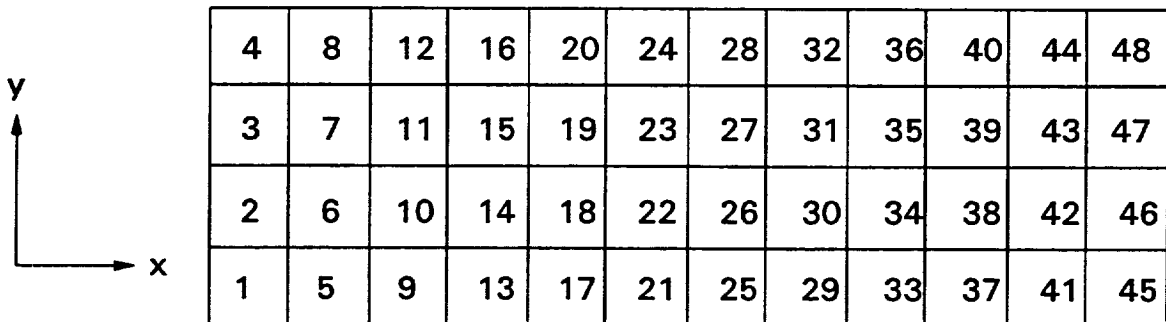


**CANTILEVER BEAM UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

FINITE ELEMENT MESH SHOWING NODE NUMBERS



FINITE ELEMENT MESH SHOWING ELEMENT NUMBERS



HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 1

FILE: BNNUSCF DEMO

A1

VM/SP CONVERSATIONAL MONITOR SYSTEM

TITLE=PROBLEM # 1, STATIC ANALYSIS FOR BEAM, 12x4 MESH
 TITLE=ONE END FIXED, CONC. LOAD(10 LB) AT CENTER TOP OF 2nd END,
 TITLE=UNIFORM TEMP. OF 1000 F (REFERENCE TEMP. = 70 F),
 TITLE=L=2", W=0.5", T=0.125", 4(0/45/-45/90)PLIES, FVR=.4,
 TITLE=NO FABRICATION EFFECTS, NO FIBER DEGRADATION EFFECTS.

SPLATE

PLATE

FORCE

TEMPERATURE

PLYORDER

UNSYMMETRICAL

ENDOPTIONS

```

4
2
1 13 5 4
0.0 2.0
2
2
1 1 1 1 5 10
1.0
1
0
6
2 2
12
0.0 0.0 0.0625 -0.0625
0.0 0.5 0.0625 -0.0625
0
2.00 0.0 0.0625 -0.0625
2.00 0.5 0.0625 -0.0625
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 0.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 45.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 -45.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 90.0
    
```

HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 1 (CONTINUED)

FILE: BNNUSCF DEMO A1 VM/SP CONVERSATIONAL MONITOR SYSTEM

```
4 3
1 2
  0.
1000. 1000. 0. 0.
1000. 1000. 0. 0.
1000. 1000. 0. 0.
1000. 1000. 0. 0.
63 3
  -10.
1 5 1 1
1 5 1 2
1 5 1 3
1 5 1 4
1 5 1 5
1 5 1 6
1 65
1 65
3 3 63 63
1 4
  0.0
```

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 1

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: BNNUSCF OUT A1 VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
63	0.617E-02	-0.291E-04	-0.628E-02	0.242E-02	0.332E-02	-0.556E-05

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.973E+05	-0.103E+05	0.000E+00	-0.230E+03	0.789E+02	0.421E+03
2	-0.438E+05	-0.361E+05	0.000E+00	0.295E+05	-0.757E+03	-0.518E+03
3	-0.415E+05	-0.342E+05	0.000E+00	-0.304E+05	-0.518E+03	0.757E+03
4	0.174E+05	-0.630E+05	0.000E+00	-0.365E+03	-0.421E+03	0.789E+02

NODE # 3

MICROSTRESSES (in psi. units)		IN PLY NO.		4 AT TIME		0.0000000	
NO.	STRESS FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY
1	NOFS 0.7000E+01	NOMS 0.1900E+02	NODS 0.1300E+02	MOLS 0.7000E+01			
2	SIGF11 0.7530E+05	SIGM11A -0.2125E+05	SIGD11B 0.2291E+05	SIGL11 0.1737E+05			
3	SIGF22 -0.6195E+05	SIGM22A -0.6465E+05	SIGD22B -0.9125E+05	SIGL22 -0.6297E+05			
4	SIGF12 -0.2291E+04	SIGM22B -0.9125E+05	SIGD22C -0.6195E+05	SIGL33 0.0000E+00			
5	SIGF23 0.5011E+03	SIGM22C -0.6195E+05	SIGD12B -0.1171E+04	SIGL12 -0.3647E+03			
6	SIGF13 -0.2643E+04	SIGM12A -0.2204E+03	SIGD12C -0.1370E+04	SIGL23 -0.4207E+03			
7	SIGF33 0.1357E+05	SIGM12B -0.3835E+03	SIGD23B 0.2562E+03	SIGL13 0.7888E+02			
8		SIGM12C -0.4485E+03	SIGD23C 0.2996E+03				
9		SIGM23A 0.4820E+02	SIGD13B -0.1351E+04				
10		SIGM23B 0.8387E+02	SIGD13C -0.1580E+04				
11		SIGM23C 0.9809E+02	SIGD33B -0.2630E+05				
12		SIGM13A -0.2542E+03	SIGD33C 0.1357E+05				
13		SIGM13B -0.4424E+03	SIGD11C 0.2291E+05				
14		SIGM13C -0.5174E+03					
15		SIGM33A -0.2531E+05					
16		SIGM33B -0.2630E+05					
17		SIGM33C 0.1357E+05					
18		SIGM11B -0.2125E+05					
19		SIGM11C -0.2125E+05					

TIME REQUIRED TO CARRY OUT THE ANALYSIS	0.079 SEC.
TIME REQUIRED TO : READ IN DATA	0.013 SEC.
DO PREPROCESSING	0.073 SEC.

HITCAN Demonstration Manual - Version I.0

DEMONSTRATION PROBLEM NO. 2

PROBLEM TYPE:

Static analysis of a solid plate type structure using plate element subjected to thermo-mechanical loading.

PROBLEM DESCRIPTION:

A 6" long, 4" wide, and 0.125" thick plate with all 4 edges simply supported is subjected to a concentrated load of 200 lb at the top center and a uniform temperature increase from 70 to 1000 F. The plate is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (0/45/-45/90) plies of equal thickness with 0.4 fiber volume ratio. The ply lay-up is such that the 0 degree ply is at the top and the 90 degree at the bottom of the plate. The material properties at the reference temperature of 70 F are listed in Table II. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

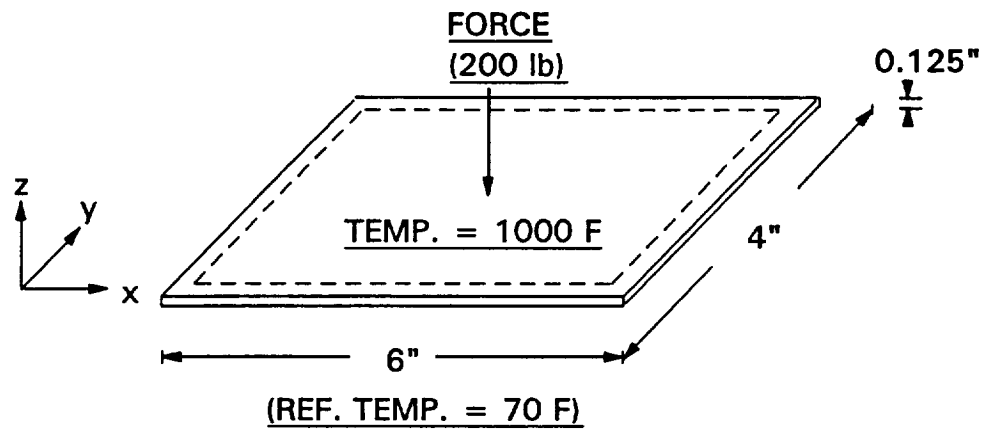
MODELING HINTS:

The finite element mesh consists of 6 elements in x-direction and 4 in y-direction (IU = 7 and JU = 5 on card group # 3). The material property data file, "DATAS BANK" is included in Appendix 1.

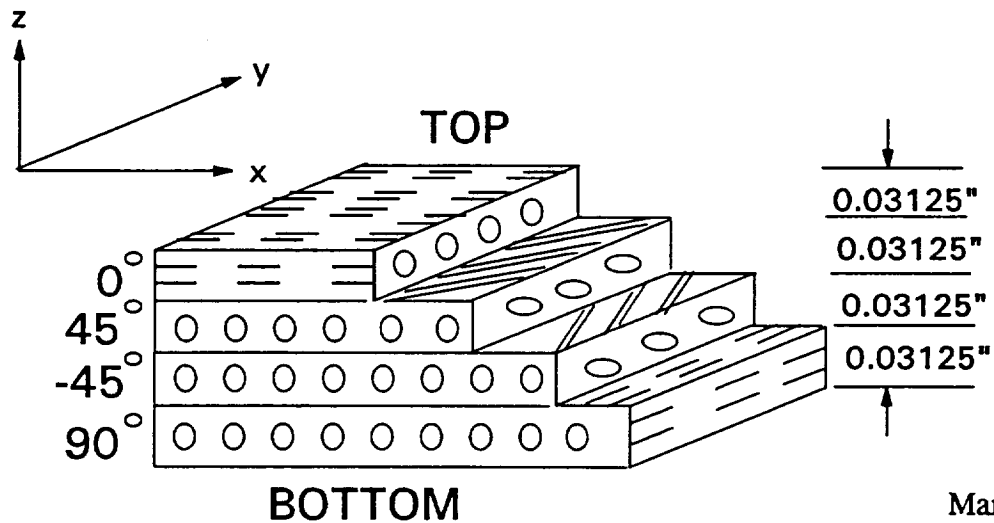
PROBLEM # 2

**SIMPLY SUPPORTED PLATE UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING

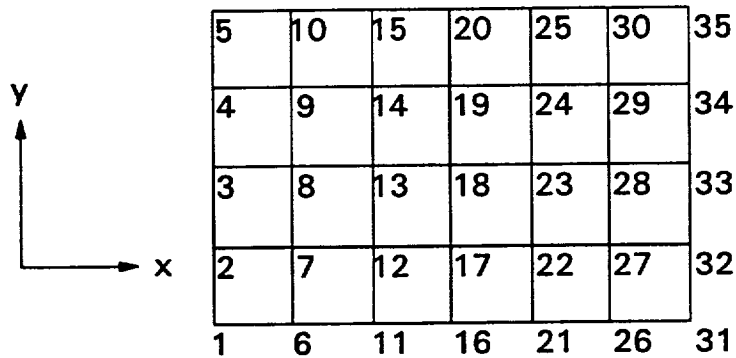


PLY LAY-UP IN Z-DIRECTION

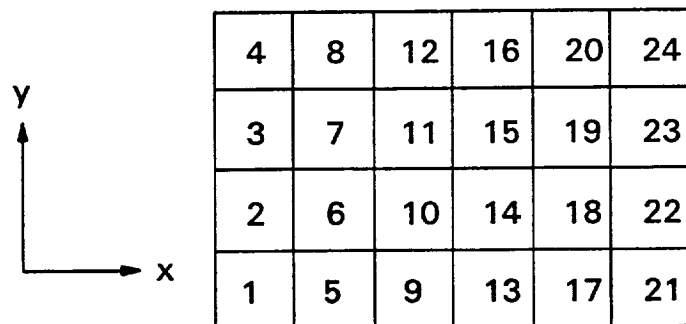


**SIMPLY SUPPORTED PLATE UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

FINITE ELEMENT MESH SHOWING NODE NUMBERS



FINITE ELEMENT MESH SHOWING ELEMENT NUMBERS



HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 2

FILE: PNNUSCF DEMO A1 VM/SP CONVERSATIONAL MONITOR SYSTEM

TITLE=PROBLEM # 2, STATIC ANALYSIS FOR PLATE,
 TITLE=S.S. AT ALL EDGES, CONC. LOAD(200 LB) AT CENTER POINT,
 TITLE=UNIFORM TEMP. OF 1000 F (REFERENCE TEMP. = 70 F),
 TITLE=L=6", W=4", T=0.125", 4(0/45/-45/90)PLIES, FVR=.4, 6X4 MESH,
 TITLE=NO FABRICATION EFFECTS, NO FIBER DEGRADATION EFFECTS.

SPLATE

PLATE

FORCE

TEMPERATURE

PLYORDER

UNSYMMETRICAL

ENDOPTION

4

2

1 7 5 4
 0.0 6.0

2

2

1 1 1 1 5 10
 1.0

1

0

11

2 2

6

0.0 0.0 0.0625 -0.0625
 0.0 4.0 0.0625 -0.0625

0

6.00 0.0 0.0625 -0.0625
 6.00 4.0 0.0625 -0.0625

0.0 100.0 0.0 100.0 0.0 100.0

SICA TI15 0.03125 0.0 0.40 0.0

0.0 100.0 0.0 100.0 0.0 100.0

SICA TI15 0.03125 0.0 0.40 45.0

0.0 100.0 0.0 100.0 0.0 100.0

SICA TI15 0.03125 0.0 0.40 -45.0

0.0 100.0 0.0 100.0 0.0 100.0

SICA TI15 0.03125 0.0 0.40 90.0

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 2 (CONTINUED)

FILE: PNNUSCF DEMO A1 VM/SP CONVERSATIONAL MONITOR SYSTEM

```

4 3
1 2
  0.
 1000. 1000. 0. 0.
 1000. 1000. 0. 0.
 1000. 1000. 0. 0.
 1000. 1000. 0. 0.
18 3
  -200.
 1 5 1 3
 1 5 1 4
31 35 1 3
31 35 1 4
 1 31 5 3
 1 31 5 5
 5 35 5 3
 5 35 5 5
 1 35 1 6
18 18 0 1
18 18 0 2
 1 35
 1 35
 7 7 18 18
 1 1 3 3 4 4
 0.0
  
```

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 2

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: PNNUSCF OUT A1

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
18	-0.725E-38	0.128E-38	-0.978E-02	0.105E-14	-0.499E-14	-0.125E-30

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 18

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	0.142E+05	0.312E+04	0.000E+00	-0.159E+03	-0.452E-10	0.142E-10
2	0.634E+04	-0.112E+04	0.000E+00	0.273E+03	0.470E-10	-0.900E-10
3	0.654E+02	-0.623E+04	0.000E+00	-0.922E+03	-0.900E-10	-0.470E-10
4	-0.435E+04	-0.123E+05	0.000E+00	0.192E+03	-0.142E-10	-0.452E-10

NODE # 7

MICROSTRESSES (in psi. units)		IN PLY NO.		1 AT TIME		0.0000000		
NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	0.4841E+05	SIGM11A	-0.8592E+04	SIGD11B	0.5591E+04	SIGL11	0.1421E+05
3	SIGF22	0.1926E+05	SIGM22A	-0.2459E+05	SIGD22B	-0.2184E+05	SIGL22	0.3118E+04
4	SIGF12	-0.9997E+03	SIGM22B	-0.2184E+05	SIGD22C	0.1926E+05	SIGL33	0.0000E+00
5	SIGF23	0.9019E-10	SIGM22C	0.1926E+05	SIGD12B	-0.5111E+03	SIGL12	-0.1591E+03
6	SIGF13	-0.2841E-09	SIGM12A	-0.9616E+02	SIGD12C	-0.5977E+03	SIGL23	-0.4522E-10
7	SIGF33	0.1552E+05	SIGM12B	-0.1673E+03	SIGD23B	0.4611E-10	SIGL13	0.1420E-10
8			SIGM12C	-0.1957E+03	SIGD23C	0.5392E-10		
9			SIGM23A	0.8675E-11	SIGD13B	-0.1453E-09		
10			SIGM23B	0.1510E-10	SIGD13C	-0.1699E-09		
11			SIGM23C	0.1766E-10	SIGD33B	-0.2506E+05		
12			SIGM13A	-0.2733E-10	SIGD33C	0.1552E+05		
13			SIGM13B	-0.4756E-10	SIGD11C	0.5591E+04		
14			SIGM13C	-0.5562E-10				
15			SIGM33A	-0.2654E+05				
16			SIGM33B	-0.2506E+05				
17			SIGM33C	0.1552E+05				
18			SIGM11B	-0.8592E+04				
19			SIGM11C	-0.8592E+04				

TIME REQUIRED TO CARRY OUT THE ANALYSIS	0.044 SEC.
TIME REQUIRED TO : READ IN DATA	0.014 SEC.
DO PREPROCESSING	0.041 SEC.

HITCAN Demonstration Manual - Version I.0

DEMONSTRATION PROBLEM NO. 3

PROBLEM TYPE:

Static analysis of a solid ring type structure using plate element subjected to thermo-mechanical loading.

PROBLEM DESCRIPTION:

A cantilever quarter (90 degree segment) ring of 1" radius and 0.125 x 0.125" cross-section is subjected to a concentrated load of 10 lb at the center of free end and a uniform temperature increase from 70 to 1000 F. The ring is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (0/45/-45/90) plies of equal thickness with 0.4 fiber volume ratio. The ply lay-up is such that the 0 degree ply is at the top and the 90 degree at the bottom of the ring. The material properties at the reference temperature of 70 F are listed in Table II. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

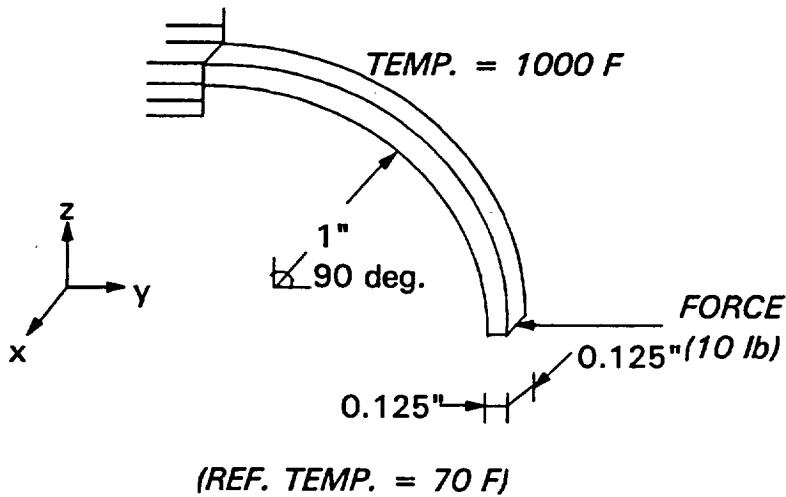
MODELING HINTS:

The finite element mesh consists of 4 elements in the x-direction and 9 along the curved edge (IU = 5 and JU = 10 on card group # 3). The material property data file, "DATAS BANK" is included in Appendix 1.

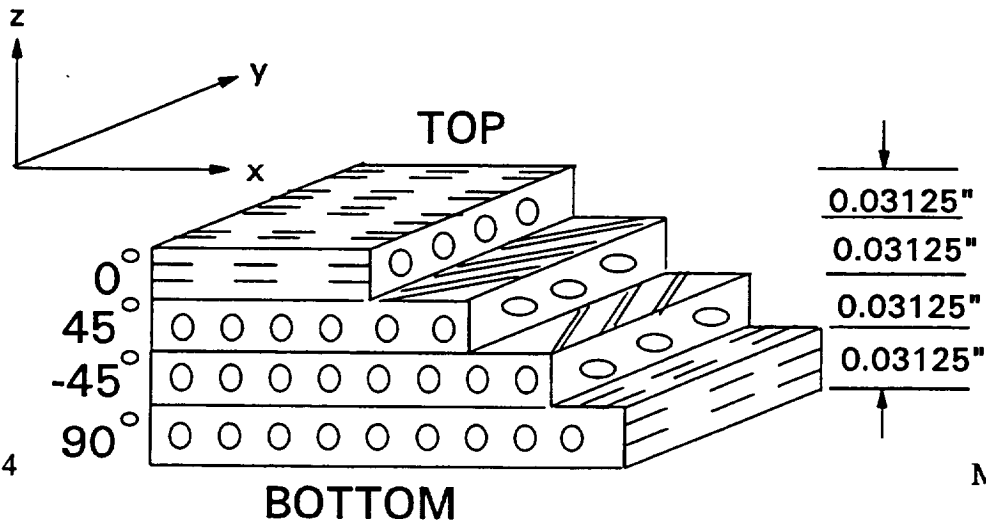
PROBLEM # 3

**CANTILEVER RING UNDER BENDING AND UNIFORM TEMPERATURE LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING

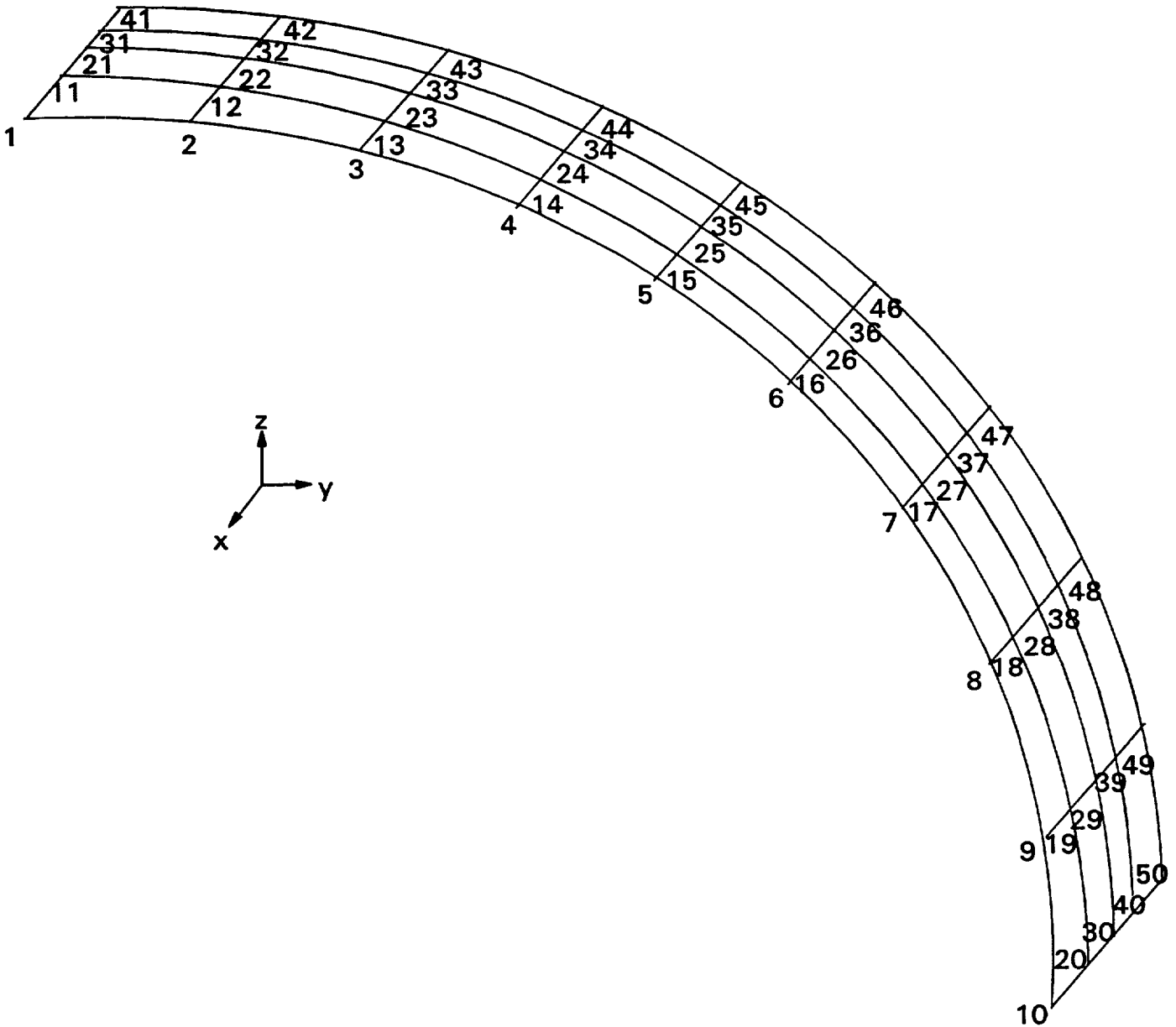


PLY LAY-UP IN Z-DIRECTION



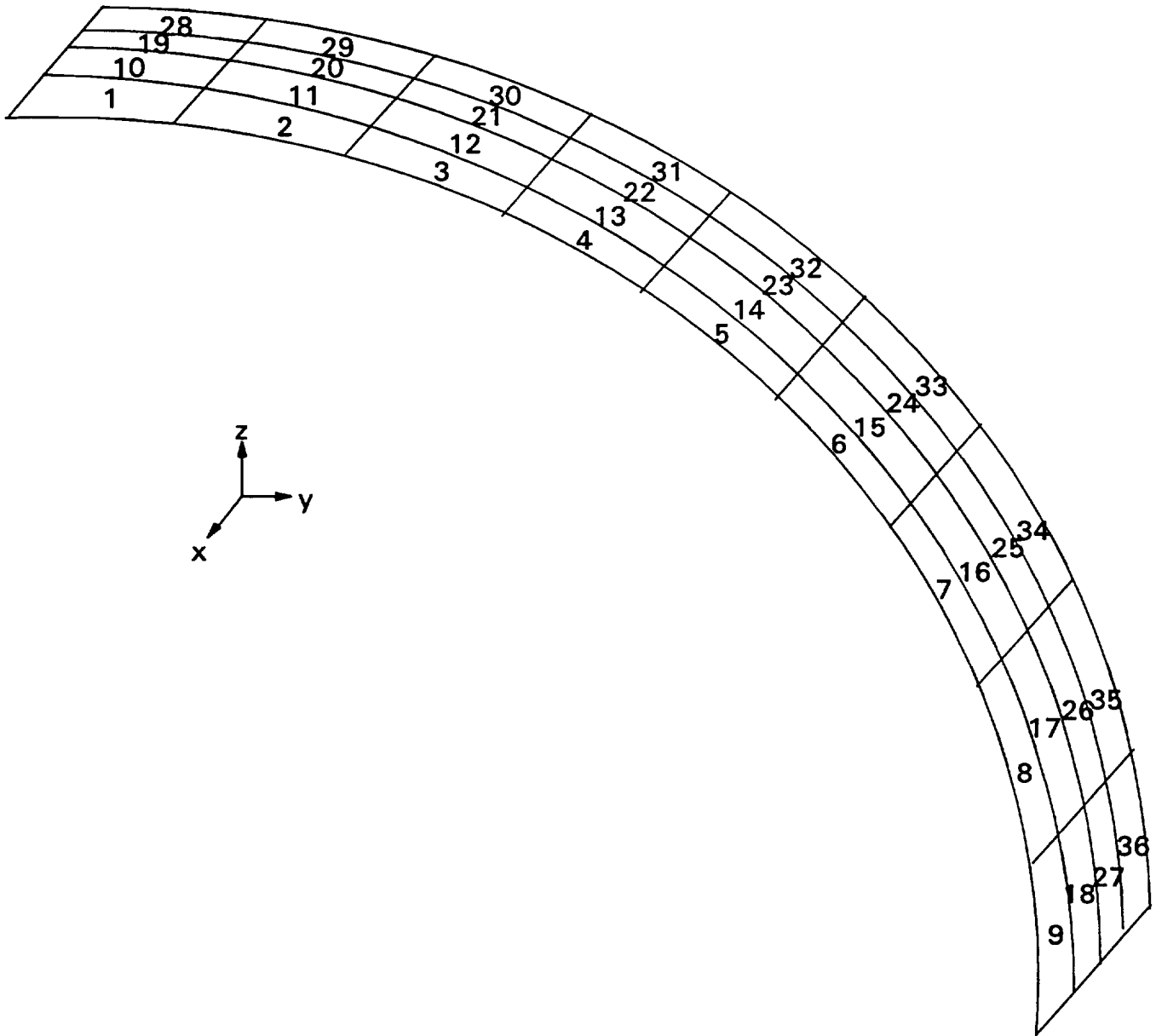
**CANTILEVER RING UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

FINITE ELEMENT MESH SHOWING NODE NUMBERS



**CANTILEVER RING UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

FINITE ELEMENT MESH SHOWING ELEMENT NUMBERS



HITCAN Demonstration Manual - Version 1.0
 INPUT DECK SETUP FOR PROBLEM # 3

FILE: RNNUSCF DEMO A1 VM/SP CONVERSATIONAL MONITO SYSTEM

TITLE=PROBLEM # 3, STATIC ANALYSIS FOR QUARTER RING,
 TITLE=FIXED AT ONE END, CONC. LOAD(10 LB) AT CENTER TOP OF OTHER END,
 TITLE=UNIFORM TEMP. OF 1000 F (REFERENCE TEMP. = 70 F),
 TITLE=R=1", W=0.125", T=0.125", 4(0/45/-45/90)PLIES, FVR=.4, 4X9 MESH
 TITLE=NO FABRICATION EFFECTS, NO FIBER DEGRADATION EFFECTS.

SPLATE
 PLATE
 FORCE
 PLYORDER
 UNSYMMETRIC
 TEMPERATURE
 ENDOPTION

```

4
5
3 5 10 4
2
2
1 1 1 1 5 10
1.0
1
0
6
10 10 10 10 10
1
0.0000 0.0000 1.0000 0.1250
0.0000 0.1737 0.9848 0.1250
0.0000 0.3420 0.9397 0.1250
0.0000 0.5000 0.8660 0.1250
0.0000 0.6428 0.7661 0.1250
0.0000 0.7661 0.6428 0.1250
0.0000 0.8660 0.5000 0.1250
0.0000 0.9397 0.3420 0.1250
0.0000 0.9848 0.1737 0.1250
0.0000 1.0000 0.0000 0.1250
1
.03125 0.0000 1.0000 0.1250
.03125 0.1737 0.9848 0.1250
.03125 0.3420 0.9397 0.1250
.03125 0.5000 0.8660 0.1250
.03125 0.6428 0.7661 0.1250
.03125 0.7661 0.6428 0.1250
.03125 0.8660 0.5000 0.1250
.03125 0.9397 0.3420 0.1250
.03125 0.9848 0.1737 0.1250
.03125 1.0000 0.0000 0.1250
1
  
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HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 3 (CONTINUED)

FILE: RNNUSCF DEMO A1 VM/SP CONVERSATIONAL MONITO SYSTEM

0.0625	0.0000	1.0000	0.1250			
0.0625	0.1737	0.9848	0.1250			
0.0625	0.3420	0.9397	0.1250			
0.0625	0.5000	0.8660	0.1250			
0.0625	0.6428	0.7661	0.1250			
0.0625	0.7661	0.6428	0.1250			
0.0625	0.8660	0.5000	0.1250			
0.0625	0.9397	0.3420	0.1250			
0.0625	0.9848	0.1737	0.1250			
0.0625	1.0000	0.0000	0.1250			
1						
.09375	0.0000	1.0000	0.1250			
.09375	0.1737	0.9848	0.1250			
.09375	0.3420	0.9397	0.1250			
.09375	0.5000	0.8660	0.1250			
.09375	0.6428	0.7661	0.1250			
.09375	0.7661	0.6428	0.1250			
.09375	0.8660	0.5000	0.1250			
.09375	0.9397	0.3420	0.1250			
.09375	0.9848	0.1737	0.1250			
.09375	1.0000	0.0000	0.1250			
0						
0.1250	0.0000	1.0000	0.1250			
0.1250	0.1737	0.9848	0.1250			
0.1250	0.3420	0.9397	0.1250			
0.1250	0.5000	0.8660	0.1250			
0.1250	0.6428	0.7661	0.1250			
0.1250	0.7661	0.6428	0.1250			
0.1250	0.8660	0.5000	0.1250			
0.1250	0.9397	0.3420	0.1250			
0.1250	0.9848	0.1737	0.1250			
0.1250	1.0000	0.0000	0.1250			
0.0	100.0	0.0	100.0	0.0	100.0	
SICA TI15	0.03125	0.0	0.40	0.0		
0.0	100.0	0.0	100.0	0.0	100.0	
SICA TI15	0.03125	0.0	0.40	45.0		
0.0	100.0	0.0	100.0	0.0	100.0	
SICA TI15	0.03125	0.0	0.40	-45.0		
0.0	100.0	0.0	100.0	0.0	100.0	
SICA TI15	0.03125	0.0	0.40	90.0		
4	3					
1	2					
0.						
1000.	1000.	0.	0.			
1000.	1000.	0.	0.			
1000.	1000.	0.	0.			

HITCAN Demonstration Manual - Version I.0

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: RHMUSCF OUT A1

VM/SP CONVERSATIONAL MONITOR

PAGE 00001

```

1 41 10 1
1 41 10 2
1 41 10 3
1 41 10 4
1 41 10 5
1 41 10 6
1 50
1 50
10 10 2 2
1 1
0.0
    
```

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
30	0.633E-03	-0.153E-01	-0.148E-01	-0.245E-01	-0.127E-02	0.137E-02

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 2

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.150E+05	0.164E+05	0.000E+00	0.348E+03	0.736E+02	-0.205E+03
2	0.213E+05	0.732E+04	0.000E+00	0.710E+04	0.199E+03	0.422E+03
3	0.267E+05	0.149E+05	0.000E+00	0.666E+03	0.422E+03	-0.199E+03
4	0.221E+05	0.279E+05	0.000E+00	-0.141E+04	0.205E+03	0.736E+02

NODE # 2

MICROSTRESSES (in psi. units)	IN PLY NO.	4 AT TIME	0.0000000	STRESS	INTERFACE	STRESS	PLY	
NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	PLY	
1	NOPS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	0.5580E+05	SIGM11A	-0.3652E+03	SIGD11B	0.9564E+04	SIGL11	0.2210E+05
3	SIGF22	0.4980E+05	SIGM22A	-0.9568E+04	SIGD22B	0.4224E+04	SIGL22	0.2795E+05
4	SIGF12	-0.8839E+04	SIGM22B	0.4224E+04	SIGD22C	0.4980E+05	SIGL33	0.0000E+00
5	SIGF23	0.4677E+03	SIGM22C	0.4980E+05	SIGD12B	-0.4519E+04	SIGL12	-0.1407E+04
6	SIGF13	0.1288E+04	SIGM12A	-0.8502E+03	SIGD12C	-0.5285E+04	SIGL23	0.2051E+03
7	SIGF33	0.1628E+05	SIGM12B	-0.1480E+04	SIGD23B	0.2391E+03	SIGL13	0.7362E+02
8			SIGM12C	-0.1730E+04	SIGD23C	0.2796E+03		
9			SIGM23A	0.4498E+02	SIGD13B	0.6587E+03		
10			SIGM23B	0.7828E+02	SIGD13C	0.7704E+03		
11			SIGM23C	0.9155E+02	SIGD33B	-0.2461E+05		
12			SIGM13A	0.1239E+03	SIGD33C	0.1628E+05		
13			SIGM13B	0.2157E+03	SIGD11C	0.9564E+04		
14			SIGM13C	0.2522E+03				
15			SIGM33A	-0.2703E+05				
16			SIGM33B	-0.2461E+05				
17			SIGM33C	0.1628E+05				
18			SIGM11B	-0.3652E+03				
19			SIGM11C	-0.3652E+03				

TIME REQUIRED TO CARRY OUT THE ANALYSIS	0.061 SEC.
TIME REQUIRED TO : READ	0.028 SEC.
DO PREPROCESSING	0.055 SEC.

DEMONSTRATION PROBLEM NO. 4

PROBLEM TYPE:

Static analysis of a solid curved panel type structure using plate element subjected to thermo-mechanical loading.

PROBLEM DESCRIPTION:

A curved panel (20 degree segment) of 6" radius, 2" width, and 0.125" thickness with both straight edges clamped and both curved edges free, is subjected to an external pressure load of 2000 psi at the top surface and a uniform temperature increase from 70 to 1000 F. The curved panel is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (0/45/-45/90) plies of equal thickness with 0.4 fiber volume ratio. The ply lay-up is such that the 0 degree ply is at the top and the 90 degree at the bottom of the curved panel. The material properties at the reference temperature of 70 F are listed in Table II. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

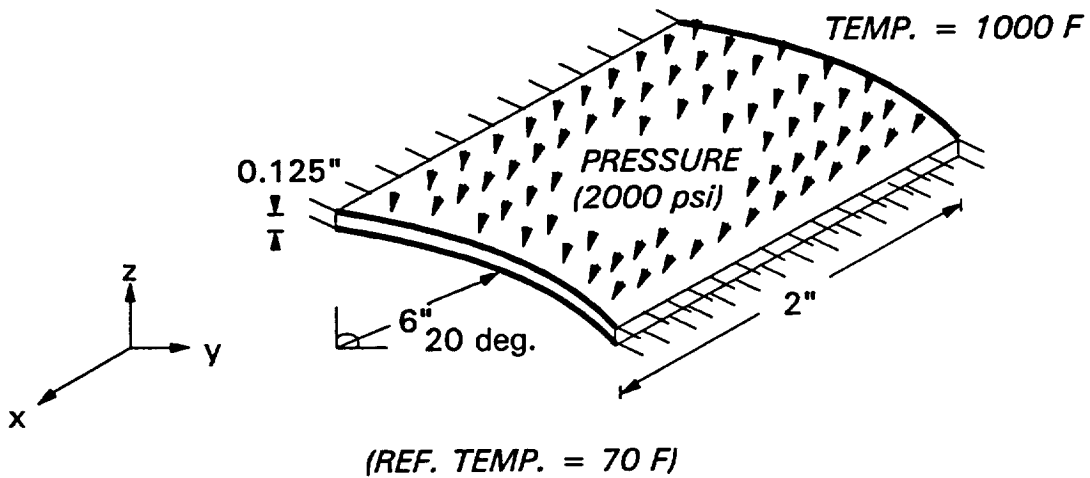
MODELING HINTS:

The finite element mesh consists of 8 elements in the x-direction and 8 along the curved edge (IU = 9 and JU = 9 on card group # 3). The material property data file, "DATAS BANK" is included in Appendix 1.

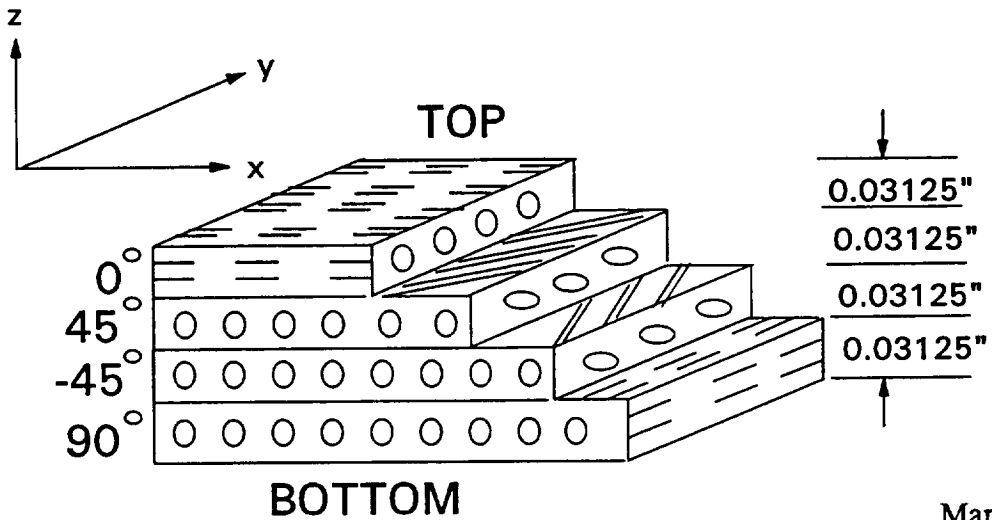
PROBLEM # 4

**FIXED-FREE CURVED PANEL UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING

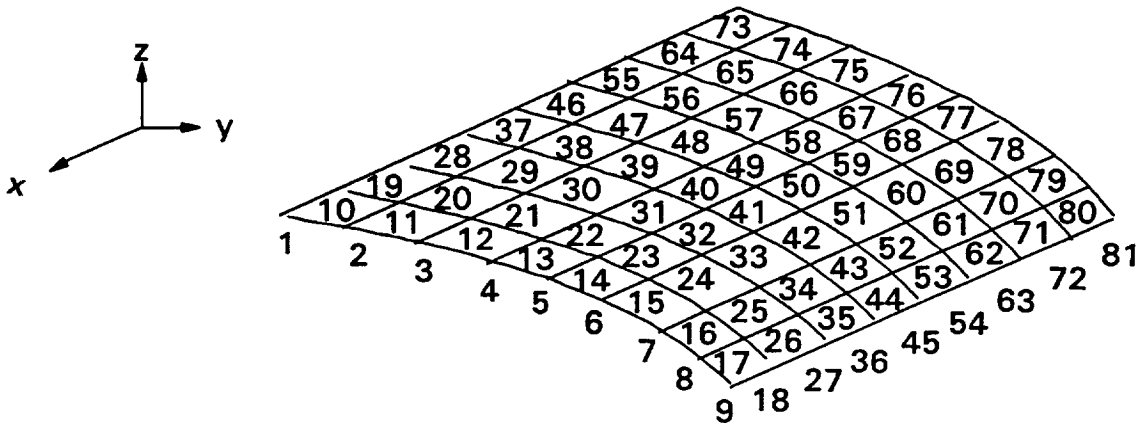


PLY LAY-UP IN Z-DIRECTION

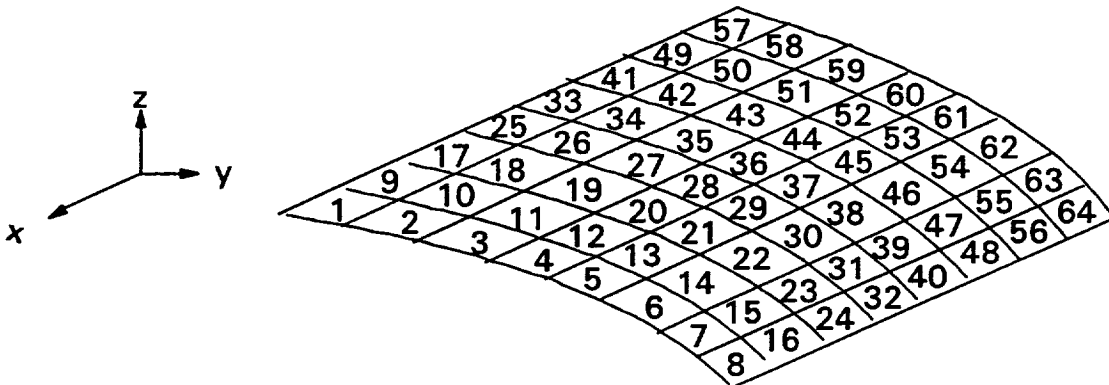


**FIXED-FREE CURVED PANEL UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

FINITE ELEMENT MESH SHOWING NODE NUMBERS



FINITE ELEMENT MESH SHOWING ELEMENT NUMBERS



HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 4

FILE: SNNUSCF DEMO A1 VM/SP CONVERSATIONAL MONITOR SYSTEM

TITLE=PROBLEM # 4, STATIC ANALYSIS FOR CURVED PANEL (20 deg. SHELL ROOF),
 TITLE=FIXED STRAIGHT EDGES, FREE CURVED EDGES, EXTERNAL PRESSURE (2000
 TITLE=PSI), UNIFORM TEMP. OF 1000 F (REFERENCE TEMP. = 70 F),
 TITLE=R=6", W=2", T=0.125", 4(0/45/-45/90)PLIES, FVR=.4, 8X8 MESH
 TITLE=NO FABRICATION EFFECTS, NO FIBER DEGRADATION EFFECTS.

SPLATE
 PLATE
 PRESSURE
 TEMPERATURE
 PLYORDER
 UNSYMMETRICAL
 ENDOPTION

```

4
2
4 9 9 4
0. 2.
2
2
1 1 1 50 95 20
1.0
0
0
11
5 5
8
0. -1.0420 5.9100 0.1250
0. -0.5230 5.9775 0.1250
0. 0. 6.0000 0.1250
0. 0.5230 5.9775 0.1250
0. 1.0420 5.9100 0.1250
0
2. -1.0420 5.9100 0.1250
2. -0.5230 5.9775 0.1250
2. 0. 6.0000 0.1250
2. 0.5230 5.9775 0.1250
2. 1.0420 5.9100 0.1250
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 0.0 100.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 45.0 100.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 -45.0 100.0
0.0 100.0 0.0 100.0 0.0 100.0

```

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 4 (CONTINUED)

FILE: SNNUSCF DEMO	A1	VM/SP CONVERSATIONAL MONITOR SYSTEM		
SICA TI15	0.03125	0.0	0.40	90.0
4 3				
1 2				
0.				
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
1000.	1000.	000.0	2000.	
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1 73 9 4				
1 73 9 5				
1 73 9 6				
9 81 9 2				
9 81 9 3				
9 81 9 4				
9 81 9 5				
9 81 9 6				
37 45 8 1				
1 81				
1 81				
5 5				
1 4				
0.0				

HITCAN Demonstration Manual - Version I.0
SAMPLE OUTPUT FOR PROBLEM # 4

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SNNUSCF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	-0.412E-02	-0.424E-05	-0.315E-02	0.118E-03	0.217E-02	-0.429E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.825E+05	0.407E+04	0.000E+00	-0.111E+03	-0.121E+03	-0.442E+02
2	-0.386E+05	-0.320E+05	0.000E+00	0.327E+05	0.250E+03	-0.116E+03
3	-0.474E+05	-0.396E+05	0.000E+00	-0.350E+05	-0.116E+03	-0.250E+03
4	0.835E+04	-0.820E+05	0.000E+00	0.561E+03	0.442E+02	-0.121E+03

NODE # 5

NO.	STRESS	FIBER	IN PLY NO.	4 AT TIME	0.0000000	STRESS	INTERFACE	STRESS	PLY
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01	
2	SIGF11	0.6395E+05	SIGM11A	-0.2872E+05	SIGD11B	0.1646E+05	SIGL11	0.8352E+04	
3	SIGF22	-0.8542E+05	SIGM22A	-0.7617E+05	SIGD22B	-0.1113E+06	SIGL22	-0.8203E+05	
4	SIGF12	0.3522E+04	SIGM22B	-0.1113E+06	SIGD22C	-0.8542E+05	SIGL33	0.0000E+00	
5	SIGF23	-0.7683E+03	SIGM22C	-0.8542E+05	SIGD12B	0.1801E+04	SIGL12	0.5606E+03	
6	SIGF13	0.2775E+03	SIGM12A	0.3388E+03	SIGD12C	0.2106E+04	SIGL23	0.4417E+02	
7	SIGF33	0.1286E+05	SIGM12B	0.5896E+03	SIGD23B	-0.3928E+03	SIGL13	-0.1209E+03	
8			SIGM12C	0.6895E+03	SIGD23C	-0.4593E+03			
9			SIGM23A	-0.7390E+02	SIGD13B	0.1419E+03			
10			SIGM23B	-0.1286E+03	SIGD13C	0.1659E+03			
11			SIGM23C	-0.1504E+03	SIGD33B	-0.2674E+05			
12			SIGM13A	0.2669E+02	SIGD33C	0.1286E+05			
13			SIGM13B	0.4645E+02	SIGD11C	0.1646E+05			
14			SIGM13C	0.5433E+02					
15			SIGM33A	-0.2498E+05					
16			SIGM33B	-0.2674E+05					
17			SIGM33C	0.1286E+05					
18			SIGM11B	-0.2872E+05					
19			SIGM11C	-0.2872E+05					

TIME REQUIRED TO CARRY OUT THE ANALYSIS	0.098 SEC.
TIME REQUIRED TO : READ IN DATA	0.014 SEC.
DO PREPROCESSING	0.091 SEC.

DEMONSTRATION PROBLEM NO. 5

PROBLEM TYPE:

Static analysis of a hollow sandwich type built-up structure using plate element subjected to thermo-mechanical loading.

PROBLEM DESCRIPTION:

A hollow built-up structure of 0.5" length, 0.2" width, 0.075" total thickness, 0.02" thickness of top plate, 0.01" thickness of bottom plate, and 3 spars in the x-z plane equally spaced in the y-direction with 0.02" thickness the z-direction, with bottom surface fixed in vertical direction, is subjected to an internal pressure load of 2000 psi and a uniform temperature increase from 70 to 1000 F. The built-up structure is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (90/0/0/90) plies of equal thickness for the top plate, 2 (90/90) plies of equal thickness for the bottom plate, and 4 (0/0/0/0) plies of equal thickness for the spars, all with 0.4 fiber volume ratio. The ply lay-up is symmetric for all parts of the structure. The material properties at the reference temperature of 70 F are listed in Table II. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

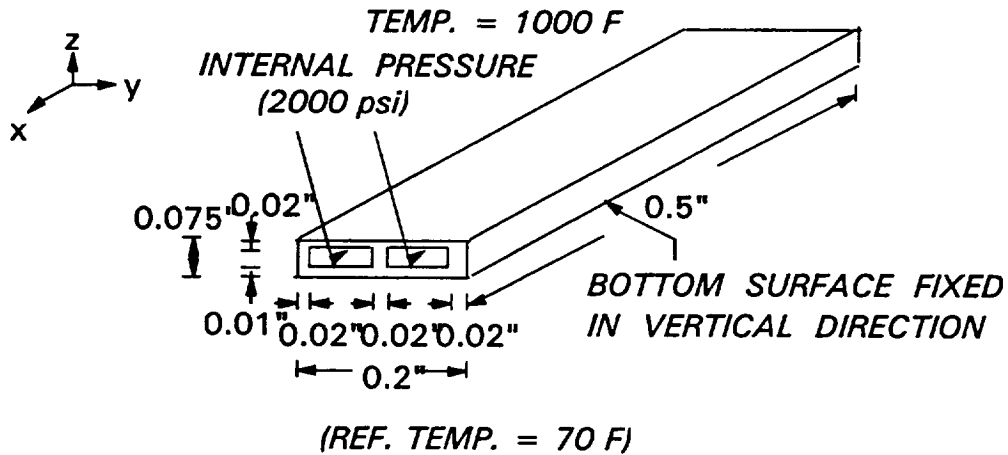
MODELING HINTS:

The finite element mesh consists of 4 elements in the x-direction and 8 in the y-direction for both the top and bottom plates and 4 elements in the x-direction and 1 element in the z-direction for all each of the 3 spars. The material property data file, "DATAS BANK" is included in Appendix 1.

PROBLEM # 5

**BOTTOM SUPPORTED BUILT-UP STRUCTURE UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, TOP:[90,0]_s, BOTTOM:[90]_s, SPARS:4[0]_s); 0.4 FIBER VOLUME RATIO**

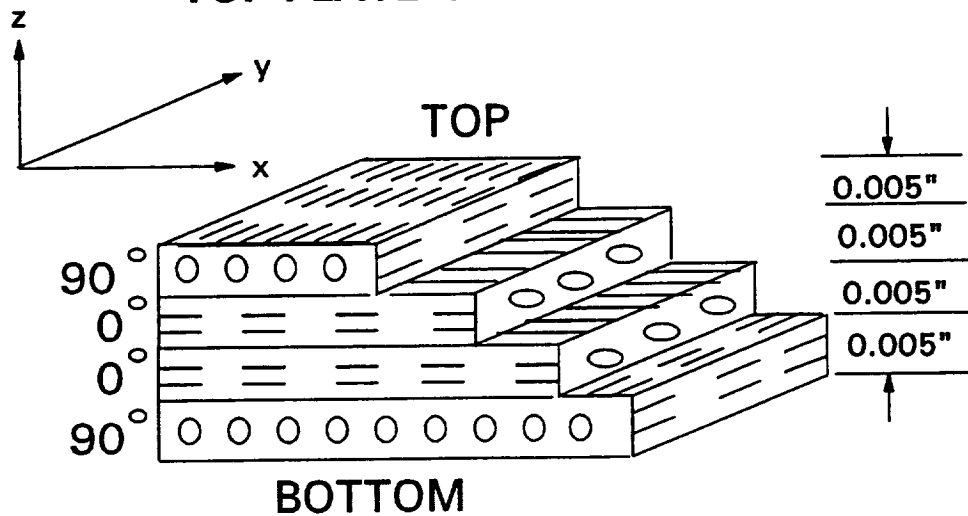
GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



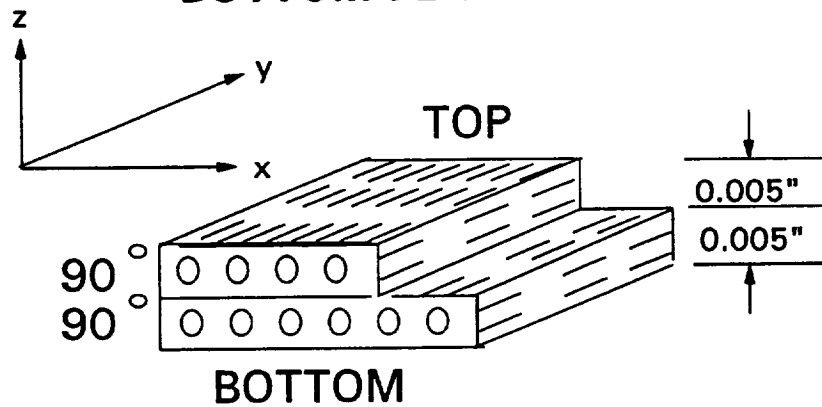
**BOTTOM SUPPORTED BUILT-UP STRUCTURE UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

PLY LAY-UP IN Z-DIRECTION

TOP PLATE OF THE PANEL

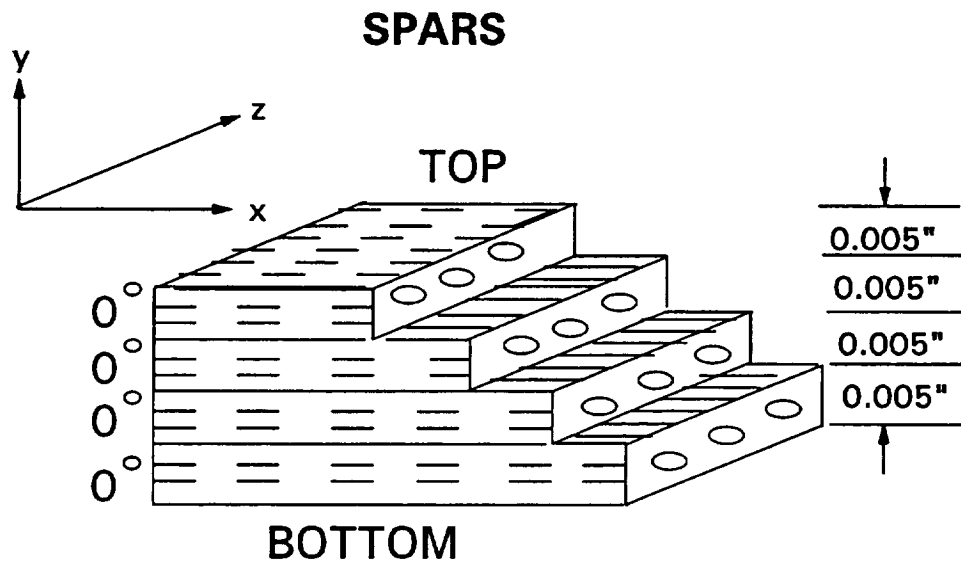


BOTTOM PLATE OF THE PANEL



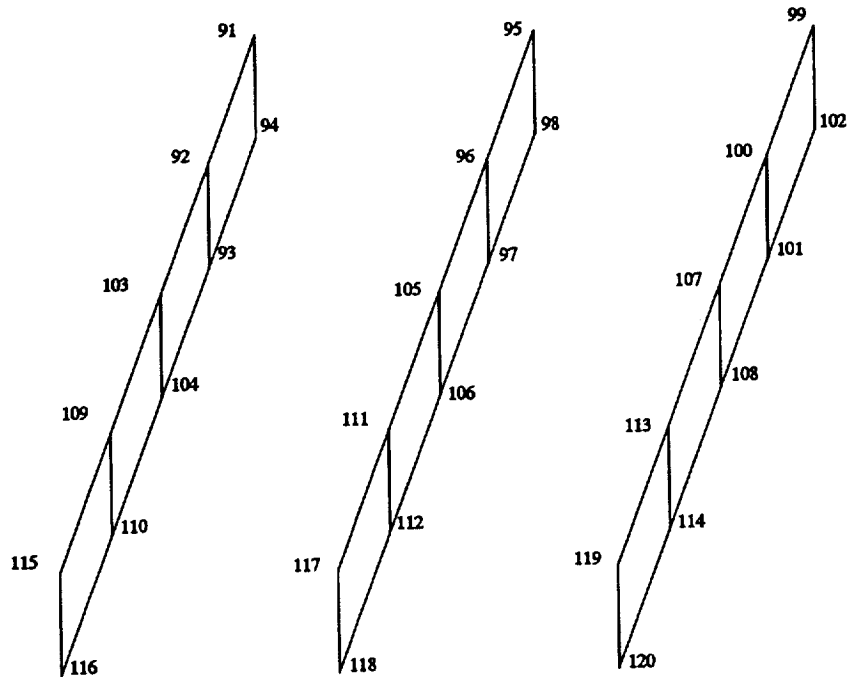
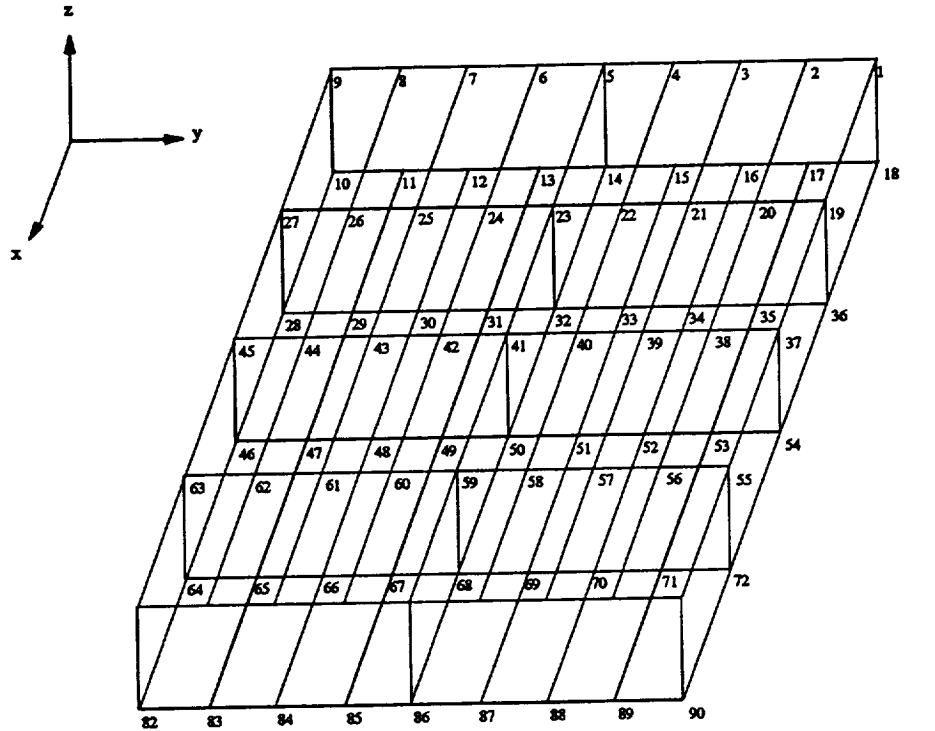
**BOTTOM SUPPORTED BUILT-UP STRUCTURE UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

PLY LAY-UP IN Y-DIRECTION



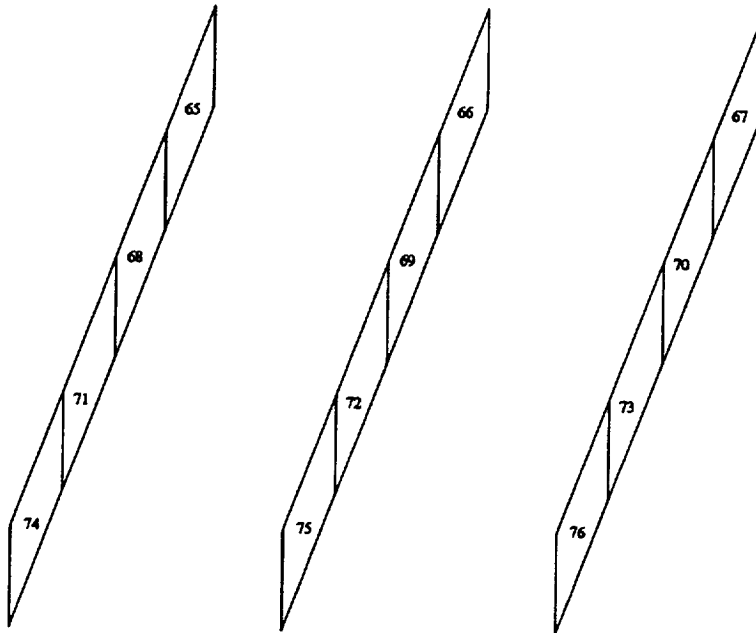
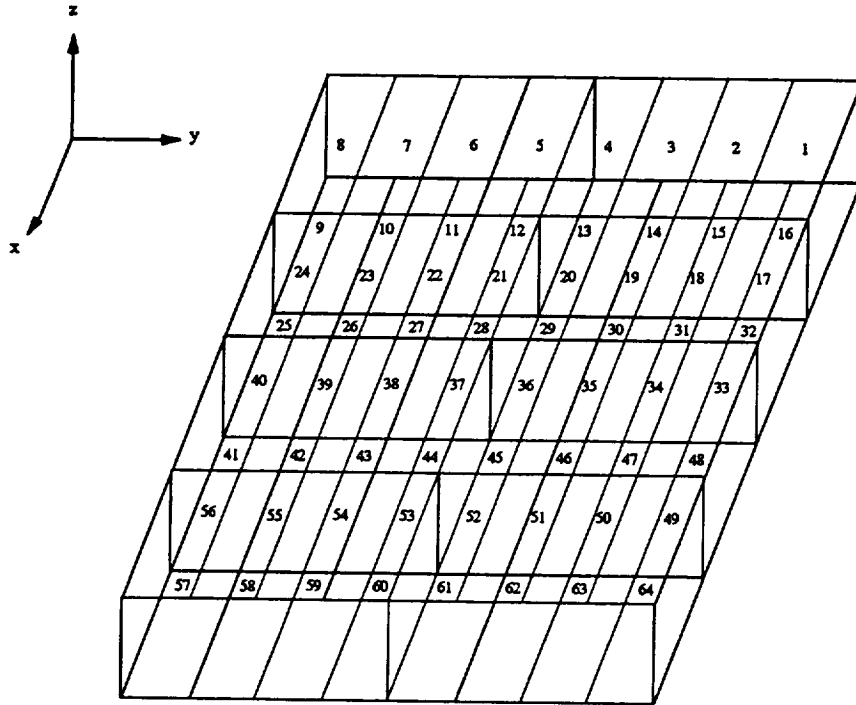
BOTTOM SUPPORTED BUILT-UP STRUCTURE UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, TOP:[90,0]_s, BOTTOM:[90] _s, SPARS:4[0] _s); 0.4 FIBER VOLUME RATIO

FINITE ELEMENT MESH SHOWING NODE NUMBERS



**BOTTOM SUPPORTED BUILT-UP STRUCTURE UNDER BENDING & UNIFORM TEMP. LOADINGS
FOR (Si C/Ti-15-3-3-3, TOP:[90,0]_s, BOTTOM:[90]_s, SPARS:4[0]_s); 0.4 FIBER VOLUME RATIO**

FINITE ELEMENT MESH SHOWING ELEMENT NUMBERS



HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 5

FILE: UNNUSCF DEMO A

VM/SP CONVERSATIONAL MONITOR SYSTEM

TITLE=PROBLEM # 5, STATIC ANALYSIS FOR BUILT-UP STRUCTURE (PANEL),
 TITLE=BOTTOM FIXED IN Z-DIRECTION, INTERNAL PRESSURE (2000 PSI),
 TITLE=UNIFORM TEMP. OF 1000 F (REFERENCE TEMP. = 70 F),
 TITLE=L=.5", W=.2", H=.075", 3 SPARS-.02"-4(0), TOP-.02"-(90/0/0/90),
 TITLE=BOTTOM-.01"-2(90), 4X8 TOP/ BOTTOM & 4X1 SPARS MESH, NO EFFECTS.

HPLATE
 PLATE
 PROFILE
 PLYORDER
 TEMPERATURE
 PRESSURE
 PANEL
 ENDOPTION

```

2
2 2 3 7
2
3 3
1 1 1 2 5 10
1.0
0
0
8
1 1 1
2 0.00
0.000 .02 0.000 .02 0.000 .02
2 0.25
0.000 .02 0.000 .02 0.000 .02
0.50
0.000 .02 0.000 .02 0.000 .02
3 3 3
3 3 3
0.0000 -0.1000 0.0400 0.0200
0.0000 0.0000 0.0400 0.0200
0.0000 0.1000 0.0400 0.0200
0.2500 -0.1000 0.0400 0.0200
0.2500 0.0000 0.0400 0.0200
0.2500 0.1000 0.0400 0.0200
0.5000 -0.1000 0.0400 0.0200
0.5000 0.0000 0.0400 0.0200
0.5000 0.1000 0.0400 0.0200
0.0000 -0.1000 -0.0350 0.0100
0.0000 0.0000 -0.0350 0.0100
0.0000 0.1000 -0.0350 0.0100
    
```

Chapter 4

March, 1992

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 5 (CONTINUED)

FILE: UNNUSCF DEMO A VM/SP CONVERSATIONAL MONITOR SYSTEM

0.2500	-0.1000	-0.0350	0.0100		
0.2500	0.0000	-0.0350	0.0100		
0.2500	0.1000	-0.0350	0.0100		
0.5000	-0.1000	-0.0350	0.0100		
0.5000	0.0000	-0.0350	0.0100		
0.5000	0.1000	-0.0350	0.0100		
0.0	0.0	0.0	100.0	0.0	100.0
SICA TI15	.00500	0.0	0.40	0.0	
0.0	0.0	0.0	100.0	0.0	100.0
SICA TI15	.00500	0.0	0.40	90.0	
2	1				
0.					
1000.	1000.	000.	2000.		
1000.	1000.	000.	2000.		
1000.	1000.	000.	2000.		
1000.	1000.	000.	2000.		
1000.	1000.	000.	2000.		
1000.	1000.	000.	2000.		
1000.	1000.	000.	2000.		
1000.	1000.	000.	2000.		
1000.	1000.	000.	2000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
1000.	1000.	2000.	000.		
37	46	9	1		
45	54	9	1		
41	50	9	2		
10	18	1	3		
28	36	1	3		
46	54	1	3		
64	72	1	3		
82	90	1	3		
1	120				
1	120				
79	79				
1	1	4	4		
0.					

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 5

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

FILE: UNNUSCF OUT A1

VM/SP CONVERSATIONAL MONITO

PAGE 00001

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	-0.764E-03	-0.147E-03	0.365E-30	-0.628E-04	0.467E-04	0.123E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.496E+04	-0.510E+04	0.000E+00	0.396E+02	0.285E+03	-0.207E+02
2	0.227E+04	-0.459E+04	0.000E+00	0.612E+01	0.443E+02	0.612E+03
3	0.267E+04	-0.394E+03	0.000E+00	0.519E+02	0.443E+02	0.612E+03
4	0.154E+05	-0.283E+04	0.000E+00	-0.976E+02	0.285E+03	-0.207E+02

NODE # 3		MICROSTRESSES (in psi. units)		IN PLY NO.	4 AT TIME	0.0000000	INTERFACE	STRESS	PLY
NO.	STRESS	FIBER	STRESS		MATRIX	STRESS			
1	NOFS.	0.7000E+01	NOMS		0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	0.5309E+05	SIGN11A		-0.9806E+04	SIGD11B	0.8536E+04	SIGL11	0.1535E+05
3	SIGF22	0.1189E+05	SIGN22A		-0.2817E+05	SIGD22B	-0.2810E+05	SIGL22	-0.2832E+04
4	SIGF12	-0.6134E+03	SIGN22B		-0.2813E+05	SIGD22C	0.1189E+05	SIGL33	0.0000E+00
5	SIGF23	0.1313E+03	SIGN22C		0.1189E+05	SIGD12B	-0.3136E+03	SIGL12	-0.9762E+02
6	SIGF13	-0.1794E+04	SIGN12A		-0.5900E+02	SIGD12C	-0.3667E+03	SIGL23	-0.2855E+03
7	SIGF33	0.1299E+05	SIGN12B		-0.1027E+03	SIGD23B	0.6713E+02	SIGL13	0.2067E+02
8			SIGN12C		-0.1201E+03	SIGD23C	0.7851E+02		
9			SIGN23A		0.1263E+02	SIGD13B	-0.9169E+03		
10			SIGN23B		0.2198E+02	SIGD13C	-0.1072E+04		
11			SIGN23C		0.2571E+02	SIGD33B	-0.2718E+05		
12			SIGN13A		-0.1725E+03	SIGD33C	0.1299E+05		
13			SIGN13B		-0.3002E+03	SIGD11C	0.8536E+04		
14			SIGN13C		-0.3511E+03				
15			SIGN33A		-0.2759E+05				
16			SIGN33B		-0.2718E+05				
17			SIGN33C		0.1299E+05				
18			SIGN11B		-0.9806E+04				
19			SIGN11C		-0.9806E+04				

 TIME REQUIRED TO CARRY OUT THE ANALYSIS
 TIME REQUIRED TO : READ IN DATA
 DO PREPROCESSING

0.125 SEC.
 0.019 SEC.
 0.100 SEC.

HITCAN Demonstration Manual - Version I.0

DEMONSTRATION PROBLEM NO. 6

PROBLEM TYPE:

Buckling analysis of a solid curved panel type structure using plate element subjected to mechanical loading.

PROBLEM DESCRIPTION:

A curved panel (20 degree segment) of 6" radius, 2" width, and 0.125" thickness with both straight edges clamped and both curved edges free, is subjected to an external pressure load of 20 psi at the top surface. The curved panel is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (0/45/-45/90) plies of equal thickness with 0.4 fiber volume ratio. The ply lay-up is such that the 0 degree ply is at the top and the 90 degree at the bottom of the curved panel. The ply lay-up is same as that used for problem # 4 shown on page 26. The material properties at the reference temperature of 70 F are listed in Table II. The exponents for material property variations according to the nonlinear multi-factor interaction model (Ref. 1) are listed in Table III. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

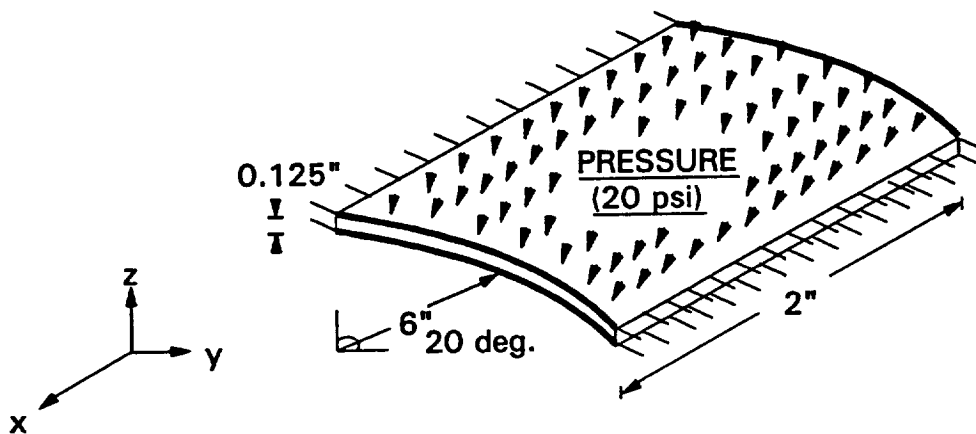
MODELING HINTS:

The finite element mesh consists of 8 elements in the x-direction and 8 along the curved edge (IU = 9 and JU = 9 on card group # 3). The mesh is same as that used for problem # 4 shown on page 27. The material property data file, "DATA BANK" is included in Appendix 1.

PROBLEM # 6

**BUCKLING OF FIXED-FREE CURVED PANEL UNDER EXTERNAL PRESSURE LOADING
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 6

FILE: SNNUBMF DEMO A1 VM/SP CONVERSATIONAL MONITOR

TITLE=PROBLEM # 6, BUCKLING ANALYSIS FOR CURVED PANEL (20 deg. SHELL
 TITLE=ROOF- MECH. LOAD ONLY), FIXED STRAIGHT EDGES, FREE CURVED EDGES
 TITLE=EXTERNAL PRESSURE (20 PSI), NO THERMAL LOAD,
 TITLE=R=6", W=2", T=0.125", 4(0/45/-45/90)PLIES, FVR=.4, 8X8 MESH
 TITLE=NO FABRICATION EFFECTS, NO FIBER DEGRADATION EFFECTS.

SPLATE

PLATE

PRESSURE

BUCKLING

PLYORDER

UNSYMMETRICAL

ENDOPTION

4

2

4 9 9 4
 0. 2.

2

2

2 1 1 1 5 10

1.0

1 0 40

0

11

5 5

8

0. -1.0420 5.9100 0.1250
 0. -0.5230 5.9775 0.1250
 0. 0. 6.0000 0.1250
 0. 0.5230 5.9775 0.1250
 0. 1.0420 5.9100 0.1250

0

2. -1.0420 5.9100 0.1250
 2. -0.5230 5.9775 0.1250
 2. 0. 6.0000 0.1250
 2. 0.5230 5.9775 0.1250
 2. 1.0420 5.9100 0.1250

0.0 100.0 0.0 100.0 0.0 100.0

SICA TI15 0.03125 0.0 0.40 0.0 100.0

0.0 100.0 0.0 100.0 0.0 100.0

SICA TI15 0.03125 0.0 0.40 45.0 100.0

0.0 100.0 0.0 100.0 0.0 100.0

SICA TI15 0.03125 0.0 0.40 -45.0 100.0

0.0 100.0 0.0 100.0 0.0 100.0

Chapter 4

March, 1992

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 6 (CONTINUED)

FILE:	SNNUBMF	DEMO	A1	VM/SP CONVERSATIONAL MONITOR	
SICA	TI15	0.03125	0.0	0.40	90.0
4	3				
1	2				
	0.	180.			
	70.	70.	0.0	0.	
	70.	70.	0.0	0.	
	70.	70.	0.0	0.	
	70.	70.	0.0	0.	
	70.	70.	0.0	0.	
	70.	70.	0.0	0.	
	70.	70.	0.0	0.	
	70.	70.	0.0	0.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
	70.	70.	0.0	20.	
1	73	9	2		
1	73	9	3		
1	73	9	4		
1	73	9	5		
1	73	9	6		
9	81	9	2		
9	81	9	3		
9	81	9	4		
9	81	9	5		
9	81	9	6		
37	45	8	1		
1	81				
1	81				
1	1	5	5		
1	1				
	0.0	180.0			
	0.0	180.0			

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 6

FILE: SNNUBMF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 0001

INPUT TEMPERATURE & PRESSURE			
TEMPERATURE		PRESSURE	
UPPER	LOWER	UPPER	LOWER
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000

EIGENVALUE NUMBER 1 VALUE = 0.194259E+04

TIME REQUIRED TO CARRY OUT THE ANALYSIS	223.331 SEC.
TIME REQUIRED TO : READ IN DATA	0.017 SEC.
DO PREPROCESSING	0.101 SEC.

DEMONSTRATION PROBLEM NO. 7

PROBLEM TYPE:

Buckling analysis of a hollow sandwich type built-up structure using plate element subjected to mechanical loading.

PROBLEM DESCRIPTION:

A hollow built-up structure of 0.5" length, 0.2" width, 0.075" total thickness, 0.02" thickness of top plate, 0.01" thickness of bottom plate, and 3 spars in the x-z plane equally spaced in the y-direction with 0.02" thickness the z-direction, with 2 long edges simply supported and 2 short edges free, is subjected to distributed axial load of 100 lb/inch on each simply supported edge. The built-up structure is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (90/0/0/90) plies of equal thickness for the top plate, 2 (90/90) plies of equal thickness for the bottom plate, and 4 (0/0/0/0) plies of equal thickness for the spars, all with 0.4 fiber volume ratio. The ply lay-up is symmetric for all parts of the structure. The ply lay-up is same as that used for problem # 5 shown on pages 33-34. The material properties at the reference temperature of 70 F are listed in Table II. The exponents for material property variations according to the nonlinear multi-factor interaction model (Ref. 1) are listed in Table III. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

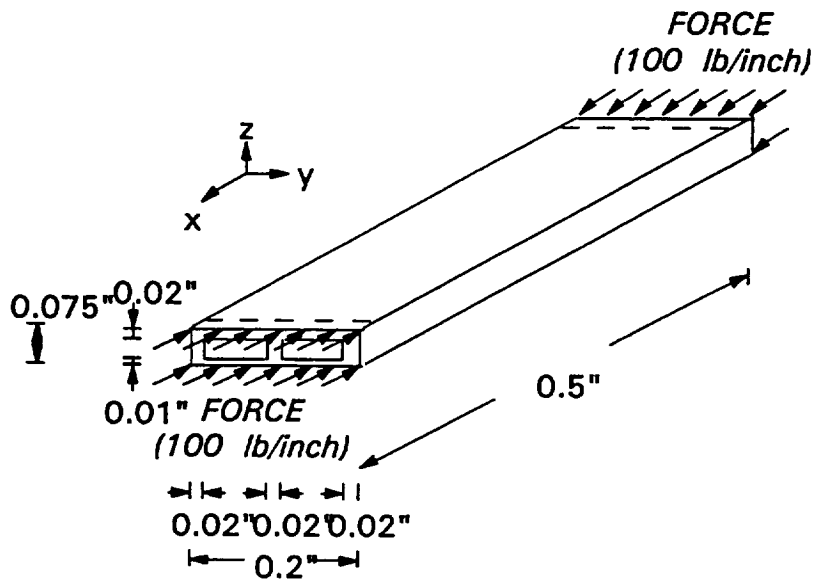
MODELING HINTS:

The finite element mesh consists of 4 elements in the x-direction and 8 in the y-direction for both the top and bottom plates and 4 elements in the x-direction and 1 element in the z-direction for all each of the 3 spars. The mesh is same as that used for problem # 5 shown on pages 35-36. The material property data file, "DATA BANK" is included in Appendix 1.

PROBLEM # 7

**BUCKLING OF SIMPLY SUPPORTED-FREE BUILT-UP STRUCTURE UNDER AXIAL LOADING
FOR (Si C/Ti-15-3-3-3, TOP:[90,0]_s, BOTTOM:[90]_s, SPARS:4[0]_s); 0.4 FIBER VOLUME RATIO**

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 7

FILE: UNNUBMF DEMO A1 VM/SP CONVERSATIONAL MONITOR

TITLE=PROBLEM # 7, BUCKLING ANALYSIS FOR BUILT-UP STRUCTURE (PANEL-
 TITLE=MECH. LOAD ONLY), S.S. AT 2 SHORTER EDGES, DISTRIBUTED AXIAL
 TITLE=COMPRESSIVE LOAD (1000 LB/INCH) ON 2 SHORTER EDGES, NO THERMAL L
 TITLE=L=.5", W=.2", H=.075", 3 SPARS-.02"-4(0), TOP-.02"-(90/0/0/90),
 TITLE=BOTTOM-.01"-2(90), 4X8 TOP/ BOTTOM & 4X1 SPARS MESH, NO EFFECTS

HPLATE
 PLATE
 PROFILE
 PLYORDER
 FORCE
 PANEL
 BUCKLING
 ENDOPTION

```

2
2 2 3 7
2
3 3
2 1 1 1 10 10
1.0
1 0 40
36
8
1 1 1
2 0.00
0.000 .02 0.000 .02 0.000 .02
2 0.25
0.000 .02 0.000 .02 0.000 .02
0.50
0.000 .02 0.000 .02 0.000 .02
3 3 3
3 3 3
0.0000 -0.1000 0.0400 0.0200
0.0000 0.0000 0.0400 0.0200
0.0000 0.1000 0.0400 0.0200
0.2500 -0.1000 0.0400 0.0200
0.2500 0.0000 0.0400 0.0200
0.2500 0.1000 0.0400 0.0200
0.5000 -0.1000 0.0400 0.0200
0.5000 0.0000 0.0400 0.0200
0.5000 0.1000 0.0400 0.0200
0.0000 -0.1000 -0.0350 0.0100
0.0000 0.0000 -0.0350 0.0100
0.0000 0.1000 -0.0350 0.0100
    
```

HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 7 (CONTINUED)

FILE: UNNUBMF	DEMO	A1	VM/SP CONVERSATIONAL MONITOR		
	0.2500	-0.1000	-0.0350	0.0100	
	0.2500	0.0000	-0.0350	0.0100	
	0.2500	0.1000	-0.0350	0.0100	
	0.5000	-0.1000	-0.0350	0.0100	
	0.5000	0.0000	-0.0350	0.0100	
	0.5000	0.1000	-0.0350	0.0100	
	0.0	0.0	0.0	100.0	0.0 100.0
SICA TI15	.00500	0.0	0.40	0.0	
	0.0	0.0	0.0	100.0	0.0 100.0
SICA TI15	.00500	0.0	0.40	90.0	
2	1				
	0.	180.			
1	1				
	1.25	2.5			
2	1				
	2.5	5.0			
3	1				
	2.5	5.0			
4	1				
	2.5	5.0			
5	1				
	2.5	5.0			
6	1				
	2.5	5.0			
7	1				
	2.5	5.0			
8	1				
	2.5	5.0			
9	1				
	1.25	2.5			
10	1				
	1.25	2.5			
11	1				
	2.5	5.0			
12	1				
	2.5	5.0			
13	1				
	2.5	5.0			
14	1				
	2.5	5.0			
15	1				
	2.5	5.0			
16	1				
	2.5	5.0			

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 7 (CONTINUED)

FILE:	UNNUBMF	DEMO	A1	VM/SP CONVERSATIONAL MONITOR
17	1			
	2.5	5.0		
18	1			
	1.25	2.5		
73	1			
	-1.25	-2.5		
74	1			
	-2.5	-5.0		
75	1			
	-2.5	-5.0		
76	1			
	-2.5	-5.0		
77	1			
	-2.5	-5.0		
78	1			
	-2.5	-5.0		
79	1			
	-2.5	-5.0		
80	1			
	-2.5	-5.0		
81	1			
	-1.25	-2.5		
82	1			
	-1.25	-2.5		
83	1			
	-2.5	-5.0		
84	1			
	-2.5	-5.0		
85	1			
	-2.5	-5.0		
86	1			
	-2.5	-5.0		
87	1			
	-2.5	-5.0		
88	1			
	-2.5	-5.0		
89	1			
	-2.5	-5.0		
90	1			
	- 1.25	-2.5		
1	18	1	3	
1	18	1	4	
1	18	1	6	

HITCAN Demonstration Manual - Version I.0

73 90 1 3
73 90 1 4
73 90 1 6
41 50 9 2
41 50 9 1
37 90
37 90
3 3 12 12
4 4
0. 180.
0. 180.

SAMPLE OUTPUT FOR PROBLEM # 7

FILE: UNNUBMF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

CONCENTRATED FORCE DATA

NODE NUMBER 1
DIRECTION OF FORCE 1

0.0000000 1.250

180.0000000 2.500

NODE NUMBER 2
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 3
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 4
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

HITCAN Demonstration Manual - Version I.0
SAMPLE OUTPUT FOR PROBLEM # 7 (CONTINUED)

PAGE 00001

FILE: UNNUBMF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

NODE NUMBER 5
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 6
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 7
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 8
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 9
DIRECTION OF FORCE 1

0.0000000 1.250

180.0000000 2.500

NODE NUMBER 10
DIRECTION OF FORCE 1

0.0000000 1.250

180.0000000 2.500

Chapter 4

March, 1992

DEMO77

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 7 (CONTINUED)

FILE: UNNUBMF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 11
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 12
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 13
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 14
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 15
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 16
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

Chapter 4

March, 1992

DEMO78

HITCAN Demonstration Manual - Version I.0
SAMPLE OUTPUT FOR PROBLEM # 7 (CONTINUED)

FILE: UNNUBHF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 17
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 18
DIRECTION OF FORCE 1

0.0000000 1.250

180.0000000 2.500

NODE NUMBER 73
DIRECTION OF FORCE 1

0.0000000 -1.250

180.0000000 -2.500

NODE NUMBER 74
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 75
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 76
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

Chapter 4

March, 1992

DEMO79

HITCAN Demonstration Manual - Version I.0
SAMPLE OUTPUT FOR PROBLEM # 7 (CONTINUED)

FILE: UNNUBMF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 77
DIRECTION OF FORCE 1
0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 78
DIRECTION OF FORCE 1
0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 79
DIRECTION OF FORCE 1
0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 80
DIRECTION OF FORCE 1
0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 81
DIRECTION OF FORCE 1
0.0000000 -1.250
180.0000000 -2.500

NODE NUMBER 82
DIRECTION OF FORCE 1
0.0000000 -1.250
180.0000000 -2.500

HITCAN Demonstration Manual - Version I.0
SAMPLE OUTPUT FOR PROBLEM # 7 (CONTINUED)

FILE: UNMUBMF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 83
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 84
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 85
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 86
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 87
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 88
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

HITCAN Demonstration Manual - Version I.0
SAMPLE OUTPUT FOR PROBLEM # 7 (CONTINUED)

FILE: UNNUBMF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 89
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 90
DIRECTION OF FORCE 1

0.0000000 -1.250

180.0000000 -2.500

EIGENVALUE NUMBER 1 VALUE = 0.313609E+02

TIME REQUIRED TO CARRY OUT THE ANALYSIS

268.824 SEC.

TIME REQUIRED TO : READ IN DATA

0.026 SEC.

DO PREPROCESSING

0.112 SEC.

DEMONSTRATION PROBLEM NO. 8

PROBLEM TYPE:

Buckling analysis of a solid curved panel type structure using plate element subjected to mechanical loading including fiber degradation.

PROBLEM DESCRIPTION:

A curved panel (20 degree segment) of 6" radius, 2" width, and 0.125" thickness with both straight edges clamped and both curved edges free, is subjected to an external pressure load of 20 psi at the top surface. The curved panel is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (0/45/-45/90) plies of equal thickness with 0.4 fiber volume ratio. The ply lay-up is such that the 0 degree ply is at the top and the 90 degree at the bottom of the curved panel. The ply lay-up is same as that used for problem # 4 shown on page 26. The material properties at the reference temperature of 70 F are listed in Table II. The exponents for material property variations according to the nonlinear multi-factor interaction model (Ref. 1) are listed in Table III. The fiber is degraded by an amount equal to 10 % of the fiber diameter, creating an interphase between the fiber and matrix. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

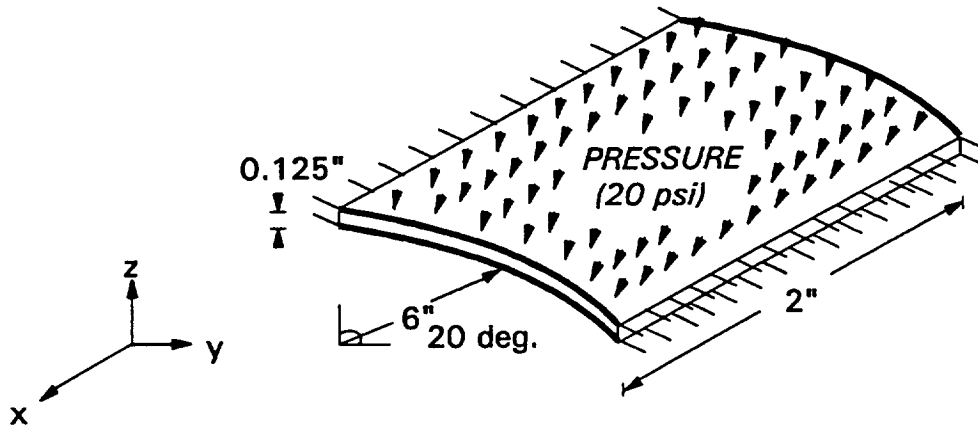
MODELING HINTS:

The finite element mesh consists of 8 elements in the x-direction and 8 along the curved edge (IU = 9 and JU = 9 on card group # 3). The mesh is same as that used for problem # 4 shown on page 27. The material property data file, "DATA BANK" is included in Appendix 1.

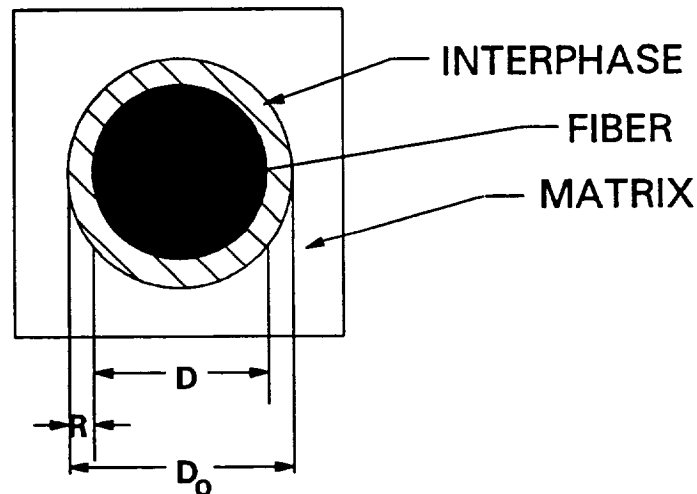
PROBLEM # 8

BUCKLING OF FIXED-FREE CURVED PANEL UNDER EXTERNAL PRESSURE LOADING WITH FIBER DEGRADATION, GIVING RISE TO AN INTERPHASE BETWEEN MATRIX & FIBER FOR (Si C/Ti-15-3-3-3, $0/\pm 45/90$); 0.4 FIBER VOLUME RATIO

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



FIBER DEGRADATION BY 10 % OF ITS DIAMETER



D_0 : Original Fiber Diameter (0.0056 inch)

D : Reduced Fiber Diameter (0.00504 inch)

R : Reduction in Fiber Diameter (by 10 %, i.e., by 0.00056 inch)

HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 8

FILE: SNYUBMF DEMO A1 VM/SP CONVERSATIONAL MONITOR

TITLE=PROBLEM # 8, BUCKLING ANALYSIS FOR CURVED PANEL (20 deg. SHELL
 TITLE=ROOF- MECH. LOAD ONLY), FIXED STRAIGHT EDGES, FREE CURVED EDGES,
 TITLE=EXTERNAL PRESSURE (20 PSI), NO THERMAL LOAD,
 TITLE=R=6", W=2", T=0.125", 4(0/45/-45/90)PLIES, FVR=.4, 8X8 MESH
 TITLE=NO FABRICATION EFFECTS, FIBER DEGRADATION EFFECTS INCLUDED.

SPLATE
 PLATE
 INTERFACE
 PRESSURE
 BUCKLING
 PLYORDER
 UNSYMMETRICAL
 ENDOPTION

```

4
2
4 9 9 4
0. 2.
2
2
2 1 1 1 5 10
1.0
1 0 40
0
11
0.1
5 5
8
0. -1.0420 5.9100 0.1250
0. -0.5230 5.9775 0.1250
0. 0. 6.0000 0.1250
0. 0.5230 5.9775 0.1250
0. 1.0420 5.9100 0.1250
0
2. -1.0420 5.9100 0.1250
2. -0.5230 5.9775 0.1250
2. 0. 6.0000 0.1250
2. 0.5230 5.9775 0.1250
2. 1.0420 5.9100 0.1250
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 0.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 45.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 -45.0
Chapter 4 100.0 0.0 100.0 0.0 100.0
    
```

March, 1992

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 8

FILE: SNYUBMF OUT A

VH/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

THE INTERFACE THICKNESS IS 0.1000 PERCENT OF THE FIBER DIAMETER

INPUT TEMPERATURE & PRESSURE		PRESSURE	
TEMPERATURE		UPPER	LOWER
UPPER	LOWER		
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000
70.000	70.000	20.000	0.000

EIGENVALUE NUMBER 1 VALUE = 0.180580E+04

TIME REQUIRED TO CARRY OUT THE ANALYSIS

224.284 SEC.

TIME REQUIRED TO : READ IN DATA
DO PREPROCESSING

0.017 SEC.

0.101 SEC.

DEMONSTRATION PROBLEM NO. 9

PROBLEM TYPE:

Buckling analysis of a hollow sandwich type built-up structure using plate element subjected to mechanical loading including fiber degradation.

PROBLEM DESCRIPTION:

A hollow built-up structure of 0.5" length, 0.2" width, 0.075" total thickness, 0.02" thickness of top plate, 0.01" thickness of bottom plate, and 3 spars in the x-z plane equally spaced in the y-direction with 0.02" thickness the z-direction, with 2 long edges simply supported and 2 short edges free, is subjected to distributed axial load of 100 lb/inch on each simply supported edge. The built-up structure is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (90/0/0/90) plies of equal thickness for the top plate, 2 (90/90) plies of equal thickness for the bottom plate, and 4 (0/0/0/0) plies of equal thickness for the spars, all with 0.4 fiber volume ratio. The ply lay-up is symmetric for all parts of the structure. The ply lay-up is same as that used for problem # 5 shown on pages 33-34. The material properties at the reference temperature of 70 F are listed in Table II. The exponents for material property variations according to the nonlinear multi-factor interaction model (Ref. 1) are listed in Table III. The fiber is degraded by an amount equal to 10 % of the fiber diameter, creating an interphase between the fiber and matrix. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

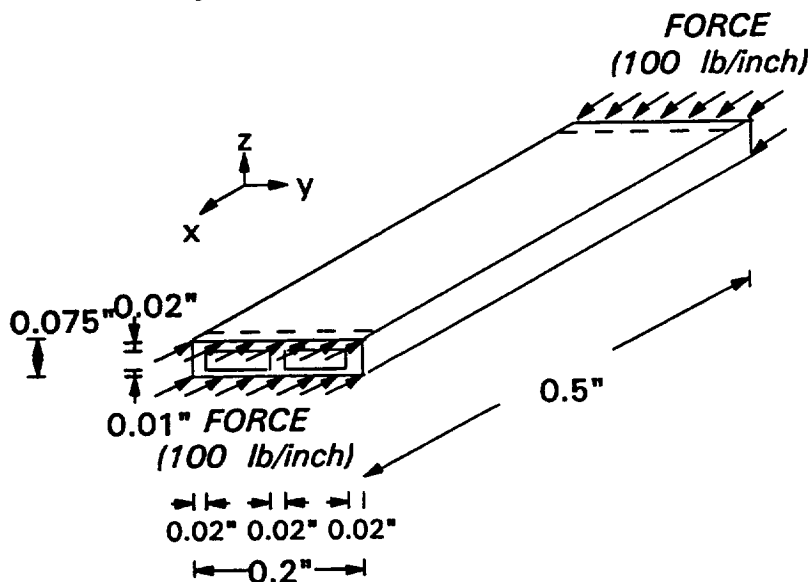
MODELING HINTS:

The finite element mesh consists of 4 elements in the x-direction and 8 in the y-direction for both the top and bottom plates and 4 elements in the x-direction and 1 element in the z-direction for all each of the 3 spars. The mesh is same as that used for problem # 5 shown on pages 35-36. The material property data file, "DATA BANK" is included in Appendix 1.

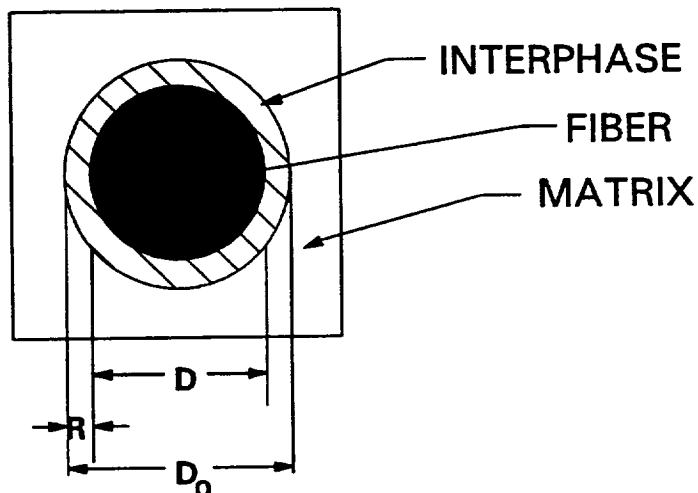
PROBLEM # 9

BUCKLING OF SIMPLY SUPPORTED-FREE BUILT-UP STRUCTURE UNDER AXIAL LOADING WITH FIBER DEGRADATION, GIVING RISE TO AN INTERPHASE BETWEEN MATRIX & FIBER FOR (Si C/Ti-15-3-3-3, TOP:[90,0]_s, BOTTOM:[90]_s, SPARS:4[0]_s); 0.4 FIBER VOLUME RATIO

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



FIBER DEGRADATION BY 10 % OF ITS DIAMETER



D_0 : Original Fiber Diameter (0.0056 inch)

D : Reduced Fiber Diameter (0.00504 inch)

R : Reduction in Fiber Diameter (by 10 %, i.e., by 0.00056 inch)

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 9

FILE: UNYUBMF DEMO A1 VM/SP CONVERSATIONAL MONITOR

TITLE=PROBLEM # 9, BUCKLING ANALYSIS FOR BUILT-UP STRUCTURE (PANEL-
 TITLE=MECH. LOAD ONLY), S.S. AT 2 SHORTER EDGES, DISTRIBUTED AXIAL
 TITLE=COMPRESSIVE LOAD (1000 LB/INCH) ON 2 SHORTER EDGES, NO THERMAL L
 TITLE=L=.5", W=.2", H=.075", 3 SPARS-.02"-4(0), TOP-.02"- (90/0/0/90),
 TITLE=BOTTOM-.01"-2(90), 4X8 TOP/ BOTTOM & 4X1 SPARS MESH, Fiber DEG.

HPLATE
 PLATE
 INTERFACE
 PROFILE
 PLYORDER
 FORCE
 PANEL
 BUCKLING
 ENDOPTION

```

  2
  2  2  3  7
  2
  3  3
  2  1  1  1  10  10
    1.0
  1  0  40
  36
  8
  0.1
  1  1  1
  2  0.00
    0.000    .02    0.000    .02    0.000    .02
  2  0.25
    0.000    .02    0.000    .02    0.000    .02
    0.50
    0.000    .02    0.000    .02    0.000    .02
  3  3  3
  3  3  3
  0.0000  -0.1000  0.0400  0.0200
  0.0000  0.0000  0.0400  0.0200
  0.0000  0.1000  0.0400  0.0200
  0.2500  -0.1000  0.0400  0.0200
  0.2500  0.0000  0.0400  0.0200
  0.2500  0.1000  0.0400  0.0200
  0.5000  -0.1000  0.0400  0.0200
  0.5000  0.0000  0.0400  0.0200
  0.5000  0.1000  0.0400  0.0200
  0.0000  -0.1000  -0.0350  0.0100
  0.0000  0.0000  -0.0350  0.0100
  
```

Chapter 4

March, 1992

HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 9 (CONTINUED)

FILE: UNYUBMF	DEMO	A1	VM/SP CONVERSATIONAL MONITOR		
0.0000	0.1000	-0.0350	0.0100		
0.2500	-0.1000	-0.0350	0.0100		
0.2500	0.0000	-0.0350	0.0100		
0.2500	0.1000	-0.0350	0.0100		
0.5000	-0.1000	-0.0350	0.0100		
0.5000	0.0000	-0.0350	0.0100		
0.5000	0.1000	-0.0350	0.0100		
0.0	0.0	0.0	100.0	0.0	100.0
SICA TI15	.00500	0.0	0.40	0.0	
0.0	0.0	0.0	100.0	0.0	100.0
SICA TI15	.00500	0.0	0.40	90.0	
2	1				
	0.	180.			
1	1				
	1.25	2.5			
2	1				
	2.5	5.0			
3	1				
	2.5	5.0			
4	1				
	2.5	5.0			
5	1				
	2.5	5.0			
6	1				
	2.5	5.0			
7	1				
	2.5	5.0			
8	1				
	2.5	5.0			
9	1				
	1.25	2.5			
10	1				
	1.25	2.5			
11	1				
	2.5	5.0			
12	1				
	2.5	5.0			
13	1				
	2.5	5.0			
14	1				
	2.5	5.0			
15	1				
	2.5	5.0			
16	1				
	2.5	5.0			

Chapter 4

March, 1992

DEMO94

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 9 (CONTINUED)

FILE:	UNYUBMF	DEMO	A1	VM/SP CONVERSATIONAL MONITOR
17	1			
	2.5	5.0		
18	1			
	1.25	2.5		
73	1			
	-1.25	-2.5		
74	1			
	-2.5	-5.0		
75	1			
	-2.5	-5.0		
76	1			
	-2.5	-5.0		
77	1			
	-2.5	-5.0		
78	1			
	-2.5	-5.0		
79	1			
	-2.5	-5.0		
80	1			
	-2.5	-5.0		
81	1			
	-1.25	-2.5		
82	1			
	-1.25	-2.5		
83	1			
	-2.5	-5.0		
84	1			
	-2.5	-5.0		
85	1			
	-2.5	-5.0		
86	1			
	-2.5	-5.0		
87	1			
	-2.5	-5.0		
88	1			
	-2.5	-5.0		
89	1			
	-2.5	-5.0		
90	1			
	-1.25	-2.5		
1	18	1	3	
1	18	1	4	
1	18	1	6	
73	90	1	3	
73	90	1	4	

Chapter 4

March, 1992

DEMO95

FILE: UNYUBMF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

```

73 90 1 6
41 50 9 2
41 50 9 1
37 90
37 90
3 3 12 12
4 4
0. 180.
0. 180.
    
```

CONCENTRATED FORCE DATA

NODE NUMBER 1
DIRECTION OF FORCE 1

```

0.0000000 1.250
180.0000000 2.500
    
```

NODE NUMBER 2
DIRECTION OF FORCE 1

```

0.0000000 2.500
180.0000000 5.000
    
```

NODE NUMBER 3
DIRECTION OF FORCE 1

```

0.0000000 2.500
180.0000000 5.000
    
```

NODE NUMBER 4
DIRECTION OF FORCE 1

```

0.0000000 2.500
180.0000000 5.000
    
```

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM 9 (CONTINUED)

FILE: UNYUBMF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 5
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 6
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 7
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 8
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 9
DIRECTION OF FORCE 1

0.0000000 1.250

180.0000000 2.500

NODE NUMBER 10
DIRECTION OF FORCE 1

0.0000000 1.250

180.0000000 2.500

Chapter 4

March, 1992

DEMO97

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM 9 (CONTINUED)

FILE: UNYUBHF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 11
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 12
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 13
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 14
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 15
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 16
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

Chapter 4

March, 1992

DEMO98

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 9 (CONTINUED)

FILE: UNYUBHF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 17
DIRECTION OF FORCE 1

0.0000000 2.500

180.0000000 5.000

NODE NUMBER 18
DIRECTION OF FORCE 1

0.0000000 1.250

180.0000000 2.500

NODE NUMBER 73
DIRECTION OF FORCE 1

0.0000000 -1.250

180.0000000 -2.500

NODE NUMBER 74
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 75
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 76
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

Chapter 4

March, 1992

DEMO99

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 9 (CONTINUED)

FILE: UNYUBHF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 77
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 78
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 79
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 80
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 81
DIRECTION OF FORCE 1

0.0000000 -1.250
180.0000000 -2.500

NODE NUMBER 82
DIRECTION OF FORCE 1

0.0000000 -1.250
180.0000000 -2.500

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 9 (CONTINUED)

FILE: UNYUBMF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 83
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 84
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 85
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 86
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 87
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

NODE NUMBER 88
DIRECTION OF FORCE 1

0.0000000 -2.500
180.0000000 -5.000

HITCAN Demonstration Manual - Version I.0
SAMPLE OUTPUT FOR PROBLEM # 9 (CONTINUED)

FILE: UNYUBMF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

NODE NUMBER 89
DIRECTION OF FORCE 1

0.0000000 -2.500

180.0000000 -5.000

NODE NUMBER 90
DIRECTION OF FORCE 1

0.0000000 -1.250

180.0000000 -2.500

EIGENVALUE NUMBER 1 VALUE = 0.285071E+02

TIME REQUIRED TO CARRY OUT THE ANALYSIS
TIME REQUIRED TO : READ IN DATA
DO PREPROCESSING

270.403 SEC.
0.026 SEC.
0.112 SEC.

DEMONSTRATION PROBLEM NO. 10

PROBLEM TYPE:

Load stepping and modal analysis of a solid curved panel type structure using plate element subjected to thermo-mechanical loading.

PROBLEM DESCRIPTION:

A curved panel (20 degree segment) of 6" radius, 2" width, and 0.125" thickness with both straight edges clamped and both curved edges free, is subjected to 4 load steps of external pressure (0-2000 psi) and uniform temperature increase (70-1000 F). The curved panel is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (0/45/-45/90) plies of equal thickness with 0.4 fiber volume ratio. The ply lay-up is such that the 0 degree ply is at the top and the 90 degree at the bottom of the curved panel. The ply lay-up is same as that used for problem # 4 shown on page 26. The material properties at the reference temperature of 70 F are listed in Table II. The exponents for material property variations according to the nonlinear multi-factor interaction model (Ref. 1) are listed in Table III. Results are to be generated both for the displacement and stress responses and for natural frequencies at each load step accounting for the nonlinear material behavior. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

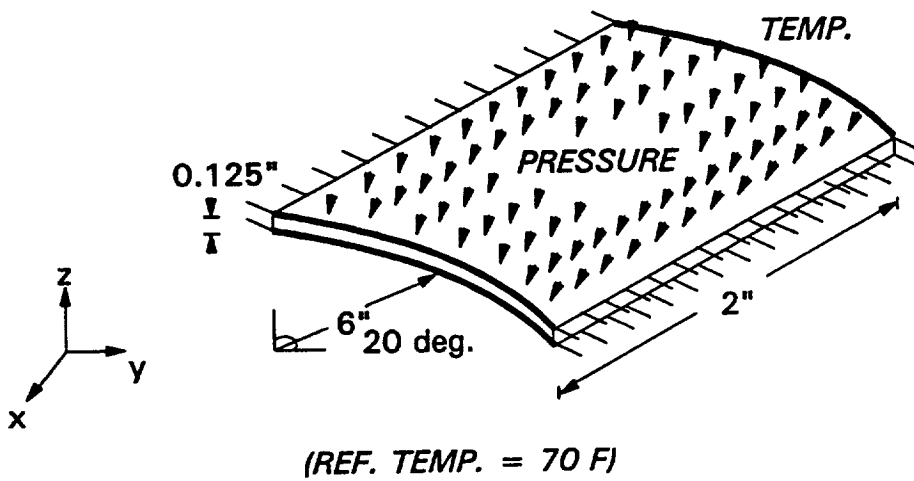
MODELING HINTS:

The finite element mesh consists of 8 elements in the x-direction and 8 along the curved edge (IU = 9 and JU = 9 on card group # 3). The mesh is same as that used for problem # 4 shown on page 27. The material property data file, "DATA BANK" is included in Appendix 1.

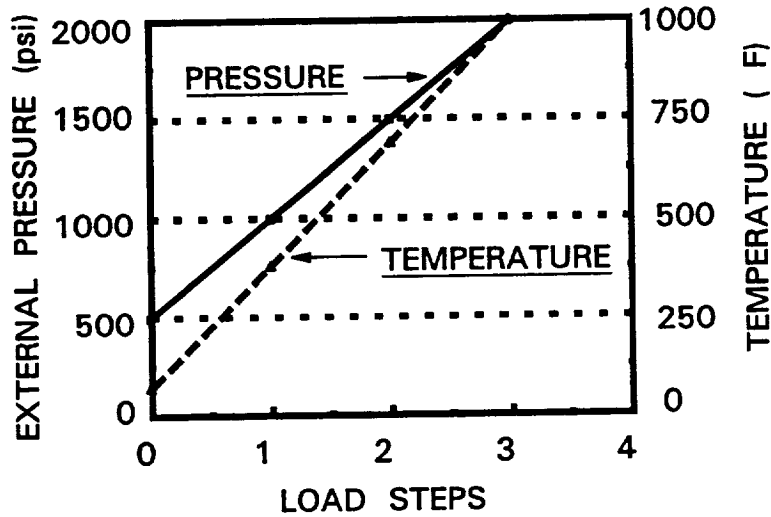
PROBLEM # 10

**FIXED-FREE CURVED PANEL UNDER BENDING & UNIFORM TEMPERATURE LOADINGS
FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



LOAD STEPPING HISTORY



HITCAN Demonstration Manual - Version I.0

INPUT DECK SETUP FOR PROBLEM # 10

FILE: SNUMCF DEMO A1 VM/SP CONVERSATIONAL MONITOR

TITLE=PROBLEMS #10,MODAL & LOAD STEPPING(BASE CASE) ANALYSIS FOR
 TITLE=CURVED PANEL(20 deg. SHELL ROOF),FIXED STRAIGHT EDGES,FREE CURVE
 TITLE=EDGES,EXTERNAL PRESSURE(2000 PSI),UNIFORM TEMP. of 1000 F(REFERE
 TITLE=TEMP. = 70 F),R=6",W=2",T=.125",4(0/45/-45/90)PLIES,FVR=.4,
 TITLE=8X8 MESH, NO FABRICATION EFFECTS, NO FIBER DEGRADATION EFFECTS.

SPLATE
 PLATE
 PRESSURE
 TEMPERATURE
 MODES
 PLYORDER
 UNSYMMETRICAL
 ENDOPTION

```

4
2
4 9 9 4
0. 2.
2
2
4 1 1 1 5 10
1.0
3 30 40
0
0
11
5 5
8
0. -1.0420 5.9100 0.1250
0. -0.5230 5.9775 0.1250
0. 0. 6.0000 0.1250
0. 0.5230 5.9775 0.1250
0. 1.0420 5.9100 0.1250
0
2. -1.0420 5.9100 0.1250
2. -0.5230 5.9775 0.1250
2. 0. 6.0000 0.1250
2. 0.5230 5.9775 0.1250
2. 1.0420 5.9100 0.1250
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 0.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 45.0
0.0 100.0 0.0 100.0 0.0 100.0
    
```


HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 10 (CONTINUED)

FILE:	SNUMCF	DEMO	A1	VM/SP CONVERSATIONAL MONITOR
	1000.	1000.	000.0	2000.
	1000.	1000.	000.0	2000.
1	73	9	2	
1	73	9	3	
1	73	9	4	
1	73	9	5	
1	73	9	6	
9	81	9	2	
9	81	9	3	
9	81	9	4	
9	81	9	5	
9	81	9	6	
37	45	8	1	
1	81			
1	81			
5	5			
1	1			
	0.0	60.0	120.0	180.0
	0.0	60.0	120.0	180.0

HITCAN Demonstration Manual - Version I.0
 SAMPLE OUTPUT FOR PROBLEM # 10

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SNNUMCF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

DISPLACEMENTS AFTER THE INITIAL LOAD AT SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	-0.373E-03	0.100E-05	-0.319E-02	0.372E-04	-0.745E-03	-0.411E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	0.661E+03	0.133E+04	0.000E+00	-0.134E+03	-0.268E+02	0.389E+02
2	-0.500E+04	-0.343E+04	0.000E+00	0.382E+04	-0.183E+02	-0.996E+02
3	-0.105E+05	-0.808E+04	0.000E+00	-0.695E+04	-0.996E+02	0.183E+02
4	0.147E+04	-0.213E+05	0.000E+00	0.302E+03	-0.389E+02	-0.268E+02

NODE # 5

MICROSTRESSES (in psi. units)	IN PLY NO.	4 AT TIME	0.0000000	STRESS	INTERFACE	STRESS	PLY	
NO.	STRESS	FIBER	STRESS	MATRIX				
1	N0FS	0.7000E+01	N0MS	0.1900E+02	N0DS	0.1300E+02	N0LS	0.7000E+01
2	SIGF11	0.1211E+05	SIGM11A	-0.5614E+04	SIGD11B	0.5881E+04	SIGL11	0.1474E+04
3	SIGF22	-0.2470E+05	SIGM22A	-0.1470E+05	SIGD22B	-0.2372E+05	SIGL22	-0.2129E+
4	SIGF12	0.1895E+04	SIGM22B	-0.2372E+05	SIGD22C	-0.2470E+05	SIGL33	0.0000E+
5	SIGF23	-0.1816E+03	SIGM22C	-0.2470E+05	SIGD12B	0.9692E+03	SIGL12	0.3017E+03
6	SIGF13	-0.2445E+03	SIGM12A	0.1824E+03	SIGD12C	0.1132E+04	SIGL23	-0.3891E+02
7	SIGF33	0.3881E+03	SIGM12B	0.3174E+03	SIGD23B	-0.9281E+02	SIGL13	-0.2682E+02
8			SIGM12C	0.3708E+03	SIGD23C	-0.1085E+03		
9			SIGM23A	-0.1746E+02	SIGD13B	-0.1250E+03		
10			SIGM23B	-0.3039E+02	SIGD13C	-0.1462E+03		
11			SIGM23C	-0.3554E+02	SIGD33B	-0.2184E+04		
12			SIGM13A	-0.2352E+02	SIGD33C	0.3881E+03		
13			SIGM13B	-0.4092E+02	SIGD11C	0.5865E+04		
14			SIGM13C	-0.4786E+02				
15			SIGM33A	-0.1441E+04				
16			SIGM33B	-0.2184E+04				
17			SIGM33C	0.3881E+03				
18			SIGM11B	-0.5614E+04				
19			SIGM11C	-0.5614E+04				

TIME 60.0000000

HITCAN Demonstration Manual - Version I.0
 SAMPLE OUTPUT FOR PROBLEM # 10 (CONTINUED)

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	-0.169E-02	-0.137E-05	-0.356E-02	0.766E-04	0.371E-03	-0.463E-04

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SNNUMCF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.257E+05	0.245E+04	0.000E+00	-0.148E+03	-0.626E+02	0.116E+02
2	-0.156E+05	-0.121E+05	0.000E+00	0.126E+05	0.773E+02	-0.112E+03
3	-0.226E+05	-0.181E+05	0.000E+00	-0.156E+05	-0.112E+03	-0.773E+02
4	0.411E+04	-0.401E+05	0.000E+00	0.438E+03	-0.116E+02	-0.626E+02

NODE # 5

MICROSTRESSES (in psi. units) IN PLY NO. 4 AT TIME 60.0000000								
NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY
1	N0FS	0.7000E+01	N0MS	0.1900E+02	N0DS	0.1300E+02	N0LS	0.7000E+01
2	SIGF11	0.3406E+05	SIGH11A	-0.1585E+05	SIGD11B	0.6038E+04	SIGL11	0.4114E+04
3	SIGF22	-0.4326E+05	SIGH22A	-0.3321E+05	SIGD22B	-0.2502E+05	SIGL22	-0.4014E+05
4	SIGF12	0.2832E+04	SIGH22B	-0.4872E+05	SIGD22C	-0.1856E+05	SIGL33	0.0000E+00
5	SIGF23	-0.4642E+03	SIGH22C	-0.4326E+05	SIGD12B	0.4690E+03	SIGL12	0.4378E+03
6	SIGF13	-0.5669E+02	SIGH12A	0.2630E+03	SIGD12C	0.5464E+03	SIGL23	-0.1157E+02
7	SIGF33	0.4454E+04	SIGH12B	0.4612E+03	SIGD23B	-0.1416E+03	SIGL13	-0.6258E+02
8			SIGH12C	0.5389E+03	SIGD23C	-0.1653E+03		
9			SIGH23A	-0.4201E+02	SIGD13B	0.9393E+02		
10			SIGH23B	-0.7398E+02	SIGD13C	0.1097E+03		
11			SIGH23C	-0.8638E+02	SIGD33B	-0.7508E+04		
12			SIGH13A	-0.7231E+01	SIGD33C	0.4066E+04		
13			SIGH13B	-0.1197E+02	SIGD11C	0.6115E+04		
14			SIGH13C	-0.1412E+02				
15			SIGH33A	-0.9231E+04				
16			SIGH33B	-0.9689E+04				
17			SIGH33C	0.4454E+04				
18			SIGH11B	-0.1585E+05				
19			SIGH11C	-0.1585E+05				

TIME 120.0000000

HITCAN Demonstration Manual - Version I.0
 SAMPLE OUTPUT FOR PROBLEM # 10 (CONTINUED)

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	-0.310E-02	-0.508E-05	-0.421E-02	0.130E-03	0.172E-02	-0.564E-04

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SNNUMCF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.525E+05	0.382E+04	0.000E+00	-0.167E+03	-0.102E+03	-0.168E+02
2	-0.262E+05	-0.205E+05	0.000E+00	0.210E+05	0.180E+03	-0.129E+03
3	-0.353E+05	-0.281E+05	0.000E+00	-0.240E+05	-0.129E+03	-0.180E+03
4	0.719E+04	-0.589E+05	0.000E+00	0.656E+03	0.168E+02	-0.102E+03

NODE # 5

MICROSTRESSES (in psi. units)	IN PLY NO.	4 AT TIME	120.0000000	INTERFACE	STRESS	PLY
NO. STRESS FIBER	STRESS	MATRIX	STRESS			
1 NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS 0.7000E+01
2 SIGF11	0.6137E+05	SIGM11A	-0.2896E+05	SIGD11B	0.9076E+04	SIGL11 0.7187E+01
3 SIGF22	-0.6194E+05	SIGM22A	-0.5094E+05	SIGD22B	-0.2312E+05	SIGL22 -0.5889E+01
4 SIGF12	0.4498E+04	SIGM22B	-0.7182E+05	SIGD22C	-0.1864E+05	SIGL33 0.0000E+00
5 SIGF23	-0.8422E+03	SIGM22C	-0.6194E+05	SIGD12B	0.8239E+03	SIGL12 0.6560E+03
6 SIGF13	0.1605E+03	SIGM12A	0.3905E+03	SIGD12C	0.9558E+03	SIGL23 0.1683E+02
7 SIGF33	0.8421E+04	SIGM12B	0.6943E+03	SIGD23B	-0.1860E+03	SIGL13 -0.1020E+03
8		SIGM12C	0.8096E+03	SIGD23C	-0.2164E+03	
9		SIGM23A	-0.7088E+02	SIGD13B	0.1068E+03	
10		SIGM23B	-0.1260E+03	SIGD13C	0.1242E+03	
11		SIGM23C	-0.1478E+03	SIGD33B	-0.6812E+04	
12		SIGM13A	0.9351E+01	SIGD33C	0.3971E+04	
13		SIGM13B	0.1831E+02	SIGD11C	0.9134E+04	
14		SIGM13C	0.2116E+02			
15		SIGM33A	-0.1699E+05			
16		SIGM33B	-0.1650E+05			
17		SIGM33C	0.8421E+04			
18		SIGM11B	-0.2896E+05			
19		SIGM11C	-0.2896E+05			

TIME

180.0000000

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 10 (CONTINUED)

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	-0.444E-02	-0.133E-04	-0.580E-02	0.136E-03	0.451E-02	-0.833E-04

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SNNUMCF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.697E+05	0.476E+04	0.000E+00	-0.460E+03	-0.731E+02	-0.684E+02
2	-0.324E+05	-0.290E+05	0.000E+00	0.279E+05	0.214E+03	-0.717E+01
3	-0.454E+05	-0.394E+05	0.000E+00	-0.311E+05	-0.717E+01	-0.214E+03
4	0.111E+05	-0.770E+05	0.000E+00	0.898E+03	0.684E+02	-0.731E+02

NODE # 5

MICROSTRESSES (in psi. units)	IN PLY NO.	4 AT TIME	180.0000000				
NO. STRESS FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY	
1 NOFS	0.7000E+01	NONS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2 SIGF11	0.9990E+05	SIGM11A	-0.4811E+05	SIGD11B	0.3757E+04	SIGL11	0.1112E+05
3 SIGF22	-0.7960E+05	SIGM22A	-0.6814E+05	SIGD22B	-0.3493E-04	SIGL22	-0.7704E+05
4 SIGF12	0.6654E+04	SIGM22B	0.0000E+00	SIGD22C	-0.1770E+05	SIGL33	0.0000E+00
5 SIGF23	-0.4820E+03	SIGM22C	-0.7960E+05	SIGD12B	0.1044E+04	SIGL12	0.8984E+03
6 SIGF13	0.6193E+03	SIGM12A	0.5295E+03	SIGD12C	0.1202E+04	SIGL23	0.6836E+02
7 SIGF33	0.1251E+05	SIGM12B	0.9568E+03	SIGD23B	0.1734E+03	SIGL13	-0.7309E+02
8		SIGM12C	0.1112E+04	SIGD23C	0.2003E+03		
9		SIGM23A	-0.4781E+02	SIGD13B	0.2208E+03		
10		SIGM23B	-0.8322E+02	SIGD13C	0.2550E+03		
11		SIGM23C	-0.9743E+02	SIGD33B	-0.4059E+04		
12		SIGM13A	0.3875E+02	SIGD33C	0.4093E+04		
13		SIGM13B	0.7404E+02	SIGD11C	0.3485E+04		
14		SIGM13C	0.8559E+02				
15		SIGM33A	-0.2514E+05				
16		SIGM33B	-0.2056E+05				
17		SIGM33C	0.1251E+05				
18		SIGM11B	-0.4811E+05				
19		SIGM11C	-0.4811E+05				

TIME REQUIRED TO CARRY OUT THE ANALYSIS 374.321 SEC.

TIME REQUIRED TO : READ IN DATA 0.021 SEC.
DO PREPROCESSING 0.128 SEC.

DEMONSTRATION PROBLEM NO. 11

PROBLEM TYPE:

Load stepping and modal analysis of a hollow sandwich type built-up structure using plate element subjected to thermo-mechanical loading.

PROBLEM DESCRIPTION:

A hollow built-up structure of 0.5" length, 0.2" width, 0.075" total thickness, 0.02" thickness of top plate, 0.01" thickness of bottom plate, and 3 spars in the x-z plane equally spaced in the y-direction with 0.02" thickness the z-direction, with bottom surface fixed in vertical direction, is subjected to 4 load steps of internal pressure (0-2000 psi) and uniform temperature increase (70-1000 F). The built-up structure is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (90/0/0/90) plies of equal thickness for the top plate, 2 (90/90) plies of equal thickness for the bottom plate, and 4 (0/0/0/0) plies of equal thickness for the spars, all with 0.4 fiber volume ratio. The ply lay-up is symmetric for all parts of the structure. The ply lay-up is same as that used for problem # 5 shown on pages 33-34. The material properties at the reference temperature of 70 F are listed in Table II. The exponents for material property variations according to the nonlinear multi-factor interaction model (Ref. 1) are listed in Table III. Results are to be generated both for the displacement and stress responses and for natural frequencies at each load step accounting for the nonlinear material behavior. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

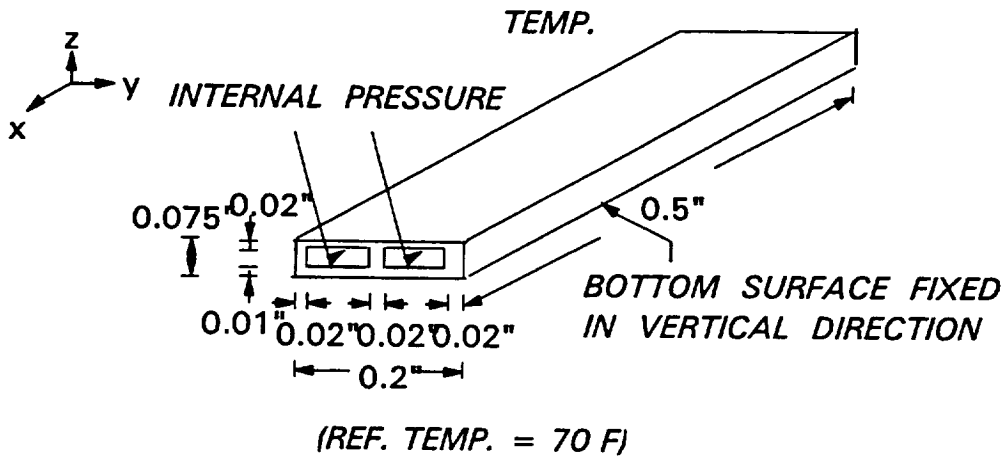
MODELING HINTS:

The finite element mesh consists of 4 elements in the x-direction and 8 in the y-direction for both the top and bottom plates and 4 elements in the x-direction and 1 element in the z-direction for all each of the 3 spars. The mesh is same as that used for problem # 5 shown on pages 35-36. The material property data file, "DATA BANK" is included in Appendix 1.

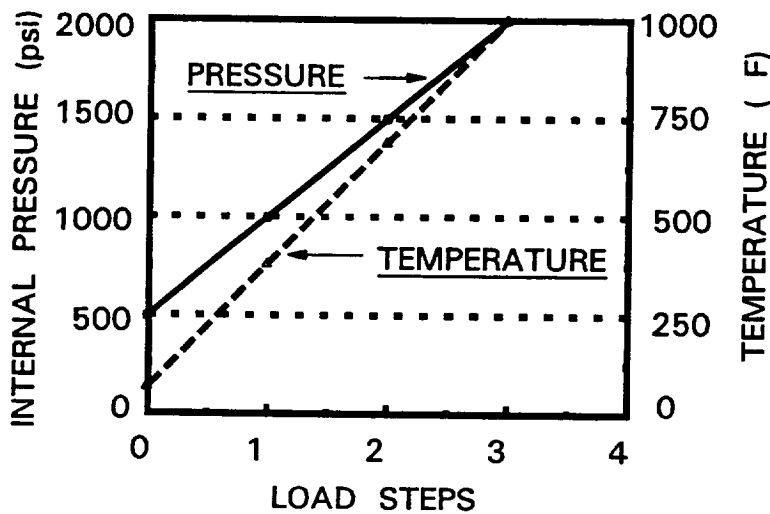
PROBLEM # 11

BOTTOM SUPPORTED BUILT-UP STRUCTURE UNDER BENDING & UNIFORM TEMP. LOADINGS FOR (Si C/Ti-15-3-3-3, TOP:[90,0]_s, BOTTOM:[90]_s, SPARS:4(0)_s); 0.4 FIBER VOLUME RATIO

GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



LOAD STEPPING HISTORY



HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 11

FILE: UNNUMCF DEMO A1 VM/SP CONVERSATIONAL MONITOR

TITLE= PANEL, BOTTOM FIXED IN Z-DIRECTION+, INSIDE AT 1000 F & 500-2000 P
 TITLE= OUTSIDE AT 1000 F & 0 PSI IN 3 MINUTES, 4X8(TOP)-8(BOT)-12(SPARE)
 TITLE= 3 SPARS-.02" THICK-4(1,-1,-1,1)PLY TYPE, TOP-.02"-4(2,1,1,2)PLIE
 TITLE= BOTTOM-.01"-2(2,2)PLIES, L=.5", W=.2", H=.075"
 TITLE= NO FABRICATION, NO FIBER DEGRADATION, 2 MODES

HPLATE
 PLATE
 PROFILE
 MODES
 PLYORDER
 TEMPERATURE
 PRESSURE
 PANEL
 ENDOPTION

2							
2	2	3	7				
2							
3	3						
4	1	1	1	5	10		
	1.0						
2	30	40					
0							
0							
8							
1	1	1					
2	0.00						
	0.000	.02	0.000	.02	0.000	.02	
2	0.25						
	0.000	.02	0.000	.02	0.000	.02	
	0.50						
	0.000	.02	0.000	.02	0.000	.02	
3	3	3					
3	3	3					
	0.0000	-0.1000	0.0400	0.0200			
	0.0000	0.0000	0.0400	0.0200			
	0.0000	0.1000	0.0400	0.0200			
	0.2500	-0.1000	0.0400	0.0200			
	0.2500	0.0000	0.0400	0.0200			
	0.2500	0.1000	0.0400	0.0200			
	0.5000	-0.1000	0.0400	0.0200			
	0.5000	0.0000	0.0400	0.0200			
	0.5000	0.1000	0.0400	0.0200			
	0.0000	-0.1000	-0.0350	0.0100			
	0.0000	0.0000	-0.0350	0.0100			
	0.0000	0.1000	-0.0350	0.0100			

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 11(CONTINUED)

FILE: UNNUMCF	DEMO	A1	VM/SP CONVERSATIONAL MONITOR
380.	380.	1000.	000.
380.	380.	1000.	000.
380.	380.	1000.	000.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.

37 46 9 1
 45 54 9 1
 41 50 9 2
 10 18 1 3
 28 36 1 3
 46 54 1 3

Chapter 4

March, 1992

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 11

```

64 72 1 3
82 90 1 3
1 120
1 120
3 3 12 12
4 4
      0.      60.      120.      180.
      0.      60.      120.      180.
    
```

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

FILE: UNNUMCF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

DISPLACEMENTS AFTER THE INITIAL LOAD AT SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	-0.524E-04	-0.981E-05	0.110E-30	-0.189E-04	0.956E-05	-0.141E-05

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.193E+04	-0.596E+03	0.000E+00	0.289E+02	0.656E+02	-0.525E+01
2	0.379E+02	-0.572E+03	0.000E+00	-0.176E+02	0.112E+02	0.141E+03
3	0.143E+03	0.449E+03	0.000E+00	-0.638E+01	0.112E+02	0.141E+03
4	0.303E+04	-0.247E+02	0.000E+00	-0.488E+01	0.656E+02	-0.525E+01

NODE # 3

MICROSTRESSES (in psi. units)		IN PLY NO. 4 AT TIME 0.0000000		STRESS		INTERFACE		STRESS		PLY	
NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY	STRESS	PLY	
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NOBS	0.1300E+02	NOLS	0.7000E+01			
2	SIGF11	0.7538E+04	SIGN11A	0.2880E+02	SIGD11B	0.2903E+04	SIGL11	0.3032E+04			
3	SIGF22	0.1035E+04	SIGN22A	-0.1853E+04	SIGD22B	-0.1778E+04	SIGL22	-0.2473E+02			
4	SIGF12	-0.3063E+02	SIGN22B	-0.1787E+04	SIGD22C	0.1035E+04	SIGL33	0.0000E+00			
5	SIGF23	-0.3351E+02	SIGN22C	0.1035E+04	SIGD12B	-0.1567E+02	SIGL12	-0.4875E+01			
6	SIGF13	0.4123E+03	SIGN12A	-0.2946E+01	SIGD12C	-0.1831E+02	SIGL23	0.6562E+02			
7	SIGF33	0.4890E+03	SIGN12B	-0.5131E+01	SIGD23B	-0.1713E+02	SIGL13	-0.5250E+01			
8			SIGN12C	-0.5996E+01	SIGD23C	-0.2004E+02					
9			SIGN23A	-0.3224E+01	SIGD13B	0.2108E+03					
10			SIGN23B	-0.5610E+01	SIGD13C	0.2465E+03					
11			SIGN23C	-0.6561E+01	SIGD33B	-0.2255E+04					
12			SIGN13A	0.3966E+02	SIGD33C	0.4890E+03					
13			SIGN13B	0.6901E+02	SIGD11C	0.2904E+04					
14			SIGN13C	0.8070E+02							
15			SIGN33A	-0.2134E+04							
16			SIGN33B	-0.2255E+04							

HTCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 11 (CONTINUED)

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

FILE: UNNUCF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

```

17          SIGM33C    0.4890E+03
18          SIGM11B    0.2880E+02
19          SIGM11C    0.2880E+02
    
```

TIME 60.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	-0.305E-03	-0.582E-04	0.203E-30	-0.354E-04	0.234E-04	0.373E-05

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.293E+04	-0.210E+04	0.000E+00	0.285E+02	0.135E+03	-0.952E+01
2	0.884E+03	-0.195E+04	0.000E+00	-0.750E+01	0.204E+02	0.288E+03
3	0.105E+04	0.633E+02	0.000E+00	0.135E+02	-0.204E+02	0.288E+03
4	0.726E+04	-0.102E+04	0.000E+00	-0.345E+02	0.135E+03	-0.952E+01

NODE # 3

MICROSTRESSES (in psi. units)	IN PLY NO.	4 AT TIME	60.0000000	INTERFACE	STRESS	PLY		
NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	STRESS		
1	N0FS	0.7000E+01	N0MS	0.1900E+02	N0DS	0.1300E+02	N0LS	0.7000E+01
2	SIGF11	0.2385E+05	SIGM11A	-0.3806E+04	SIGD11B	0.2615E+04	SIGL11	0.7255E+04
3	SIGF22	0.4524E+04	SIGM22A	-0.1059E+05	SIGD22B	-0.8047E+04	SIGL22	-0.1019E+04
4	SIGF12	-0.2335E+03	SIGM22B	-0.9850E+04	SIGD22C	0.3484E+04	SIGL33	0.0000E+00
5	SIGF23	-0.6357E+02	SIGM22C	0.4524E+04	SIGD12B	-0.1021E+03	SIGL12	-0.3450E+02
6	SIGF13	0.8840E+03	SIGM12A	-0.2058E+02	SIGD12C	-0.1188E+03	SIGL23	0.1345E+03
7	SIGF33	0.4602E+04	SIGM12B	-0.3658E+02	SIGD23B	-0.1508E+02	SIGL13	-0.9516E+01
8			SIGM12C	-0.4259E+02	SIGD23C	-0.1761E+02		
9			SIGM23A	-0.5832E+01	SIGD13B	0.2368E+03		
10			SIGM23B	-0.1025E+02	SIGD13C	0.2765E+03		
11			SIGM23C	-0.1198E+02	SIGD33B	-0.7528E+04		
12			SIGM13A	0.8070E+02	SIGD33C	0.4113E+04		
13			SIGM13B	0.1419E+03	SIGD11C	0.2618E+04		
14			SIGM13C	0.1658E+03				
15			SIGM33A	-0.1056E+05				
16			SIGM33B	-0.9778E+04				
17			SIGM33C	0.4602E+04				
18			SIGM11B	-0.3806E+04				
19			SIGM11C	-0.3806E+04				

HITCAN Demonstration Manual - Version I.0
 SAMPLE OUTPUT FOR PROBLEM # 11(CONTINUED)

FILE: UNMUMCF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

TIME 120.0000000
 TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	-0.577E-03	-0.110E-03	0.288E-30	-0.520E-04	0.362E-04	0.126E-04

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE

3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.382E+04	-0.367E+04	0.000E+00	0.225E+02	0.210E+03	-0.131E+02
2	0.181E+04	-0.340E+04	0.000E+00	0.485E+01	0.281E+02	0.450E+03
3	0.201E+04	-0.470E+03	0.000E+00	0.322E+02	0.281E+02	0.450E+03
4	0.116E+05	-0.215E+04	0.000E+00	-0.594E+02	0.210E+03	-0.131E+02

NODE # 3

MICROSTRESSES (in psi. units)	IN PLY NO.	4 AT TIME	120.0000000	STRESS	INTERFACE	STRESS	PLY	
NO.	STRESS	FIBER	STRESS	MATRIX				
1	NOPS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	0.4154E+05	SIGH11A	-0.8378E+04	SIGD11B	0.3593E+04	SIGL11	0.1161E+05
3	SIGF22	0.7798E+04	SIGH22A	-0.1941E+05	SIGD22B	-0.7343E+04	SIGL22	-0.2150E+04
4	SIGF12	-0.4248E+03	SIGH22B	-0.1721E+05	SIGD22C	0.3278E+04	SIGL33	0.0000E+00
5	SIGF23	-0.9241E+02	SIGH22C	0.7798E+04	SIGD12B	-0.9420E+02	SIGL12	-0.5945E+02
6	SIGF13	0.1461E+04	SIGH12A	-0.3517E+02	SIGD12C	-0.1092E+03	SIGL23	0.2100E+03
7	SIGF33	0.8689E+04	SIGH12B	-0.6333E+02	SIGD23B	-0.1416E+02	SIGL13	-0.1312E+02
8			SIGH12C	-0.7358E+02	SIGD23C	-0.1648E+02		
9			SIGH23A	-0.8029E+01	SIGD13B	0.2840E+03		
10			SIGH23B	-0.1432E+02	SIGD13C	0.3303E+03		
11			SIGH23C	-0.1668E+02	SIGD33B	-0.6678E+04		
12			SIGH13A	0.1248E+03	SIGD33C	0.4089E+04		
13			SIGH13B	0.2225E+03	SIGD11C	0.3595E+04		
14			SIGH13C	0.2597E+03				
15			SIGH33A	-0.1903E+05				
16			SIGH33B	-0.1646E+05				
17			SIGH33C	0.8689E+04				
18			SIGH11B	-0.8378E+04				
19			SIGH11C	-0.8378E+04				

TIME 180.0000000
 TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	-0.877E-03	-0.167E-03	0.368E-30	-0.679E-04	0.484E-04	0.232E-04

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 11(CONTINUED)

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

FILE: UNNUNCF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.453E+04	-0.535E+04	0.000E+00	0.116E+02	0.285E+03	-0.162E+02
2	0.286E+04	-0.496E+04	0.000E+00	0.225E+02	0.348E+02	0.612E+03
3	0.307E+04	-0.121E+04	0.000E+00	0.565E+02	0.348E+02	0.612E+03
4	0.162E+05	-0.348E+04	0.000E+00	-0.906E+02	0.285E+03	-0.162E+02

NODE # 3

NO.	STRESS	FIBER	IN PLY NO.	4 AT TIME	180.0000000	INTERFACE	STRESS	PLY
			STRESS	MATRIX	STRESS			
1	N0FS	0.7000E+01	N0MS	0.1900E+02	N0DS	0.1300E+02	N0LS	0.7000E+01
2	SIGF11	0.6127E+05	SIGM11A	-0.1394E+05	SIGD11B	0.5177E+04	SIGL11	0.1618E+05
3	SIGF22	0.1078E+05	SIGM22A	-0.2830E+05	SIGD22B	-0.6517E+04	SIGL22	-0.3478E+04
4	SIGF12	-0.7018E+03	SIGM22B	-0.2374E+05	SIGD22C	0.2977E+04	SIGL33	0.0000E+00
5	SIGF23	-0.1218E+03	SIGM22C	0.1078E+05	SIGD12B	-0.1340E+03	SIGL12	-0.9057E+02
6	SIGF13	0.2131E+04	SIGM12A	-0.5295E+02	SIGD12C	-0.1541E+03	SIGL23	0.2855E+03
7	SIGF33	0.1275E+05	SIGM12B	-0.9712E+02	SIGD23B	-0.1415E+02	SIGL13	-0.1624E+02
8			SIGM12C	-0.1125E+03	SIGD23C	-0.1634E+02		
9			SIGM23A	-0.9913E+01	SIGD13B	0.3237E+03		
10			SIGM23B	-0.1787E+02	SIGD13C	0.3738E+03		
11			SIGM23C	-0.2083E+02	SIGD33B	-0.5629E+04		
12			SIGM13A	0.1681E+03	SIGD33C	0.4060E+04		
13			SIGM13B	0.3046E+03	SIGD11C	0.5180E+04		
14			SIGM13C	0.3543E+03				
15			SIGM33A	-0.2742E+05				
16			SIGM33B	-0.2213E+05				
17			SIGM33C	0.1275E+05				
18			SIGM11B	-0.1394E+05				
19			SIGM11C	-0.1394E+05				

 TIME REQUIRED TO CARRY OUT THE ANALYSIS 470.028 SEC.

TIME REQUIRED TO : READ IN DATA 0.032 SEC.
 DO PREPROCESSING 0.145 SEC.

DEMONSTRATION PROBLEM NO. 12

PROBLEM TYPE:

Load stepping analysis of a solid curved panel type structure using plate element subjected to thermo-mechanical loading including fabrication load history.

PROBLEM DESCRIPTION:

A curved panel (20 degree segment) of 6" radius, 2" width, and 0.125" thickness with both straight edges clamped and both curved edges free, is subjected to 4 load steps of external pressure (0-2000 psi) and uniform temperature increase (70-1000 F). The curved panel is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (0/45/-45/90) plies of equal thickness with 0.4 fiber volume ratio. The ply lay-up is such that the 0 degree ply is at the top and the 90 degree at the bottom of the curved panel. The ply lay-up is same as that used for problem # 4 shown on page 26. The material properties at the reference temperature of 70 F are listed in Table II. The exponents for material property variations according to the nonlinear multi-factor interaction model (Ref. 1) are listed in Table III. Results are to be generated for the displacement and stress responses at each load step including the fabrication load history, accounting for the nonlinear material behavior. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

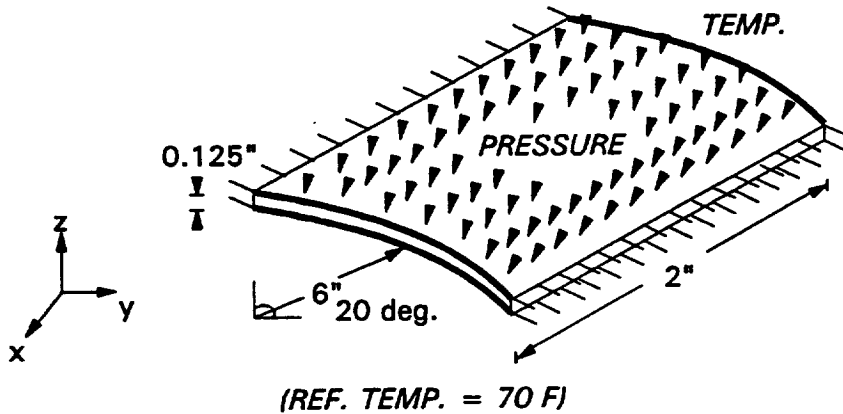
MODELING HINTS:

The finite element mesh consists of 8 elements in the x-direction and 8 along the curved edge (IU = 9 and JU = 9 on card group # 3). The mesh is same as that used for problem # 4 shown on page 27. The material property data file, "DATA BANK" is included in Appendix 1.

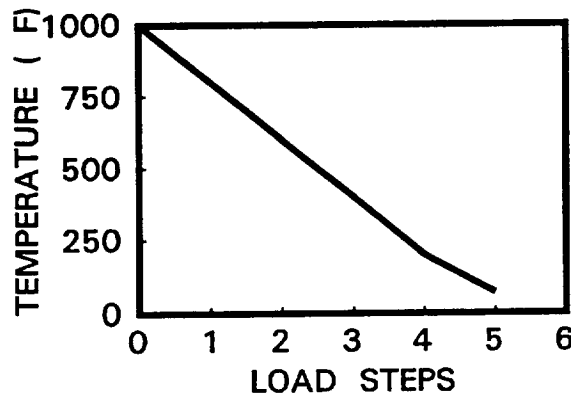
PROBLEM # 12

**FIXED-FREE CURVED PANEL UNDER BENDING & UNIFORM TEMPERATURE LOADINGS,
 FOLLOWED BY FABRICATION THERMAL COOLING LOAD
 FOR (Si C/Ti-15-3-3-3, 0/±45/90); 0.4 FIBER VOLUME RATIO**

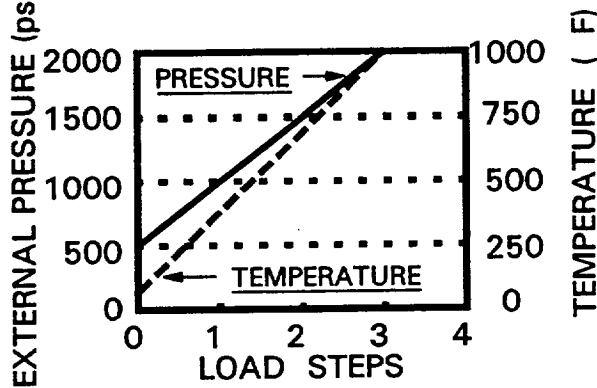
GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



FABRICATION THERMAL COOLING LOAD HISTORY



LOAD STEPPING HISTORY



HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 12-A (Fabrication Load)

FILE: SYNUMCF DEMO A1 VM/SP CONVERSATIONAL MONITOR

TITLE=PROBLEM #12A,MODAL & LOAD STEPPING(SENSITIVITY)ANALYSIS FOR CUR
 TITLE=PANEL(20 deg. SHELL ROOF),FIXED STRAIGHT EDGES,FREE CURVED EDGE
 TITLE=EXTERNAL PRESSURE(2000 PSI),UNIFORM TEMP. of 1000 F(REF. TEMP.
 TITLE=F),R=6",W=2",T=.125",4(0/45/-45/90)PLIES,FVR=.4,8X8 MESH,
 TITLE=FABRICATION EFFECTS INCLUDED, NO FIBER DEGRADATION EFFECTS.

SPLATE
 PLATE
 PRESSURE
 FABRICATION
 TEMPERATURE
 PLYORDER
 UNSYMMETRICAL
 ENDOPTION

4						
2						
4	9	9	4			
	0.		2.			
2						
2						
10	1	1	1	5	10	
	1.0					
0						
0						
6						
5	5					
8						
	0.	-1.0420	5.9100	0.1250		
	0.	-0.5230	5.9775	0.1250		
	0.	0.	6.0000	0.1250		
	0.	0.5230	5.9775	0.1250		
	0.	1.0420	5.9100	0.1250		
0						
	2.	-1.0420	5.9100	0.1250		
	2.	-0.5230	5.9775	0.1250		
	2.	0.	6.0000	0.1250		
	2.	0.5230	5.9775	0.1250		
	2.	1.0420	5.9100	0.1250		
	0.0	100.0	0.0	100.0	0.0	100.0
SICA	TI15	0.03125	0.0	0.40	0.0	
	0.0	100.0	0.0	100.0	0.0	100.0
SICA	TI15	0.03125	0.0	0.40	45.0	
	0.0	100.0	0.0	100.0	0.0	100.0
SICA	TI15	0.03125	0.0	0.40	-45.0	
	0.0	100.0	0.0	100.0	0.0	100.0

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 12-A (CONTINUED)

FILE: SYNUMCF	DEMO	A1		VM/SP CONVERSATIONAL MONITOR
400.	400.	0.	0.	
400.	400.	0.	0.	
400.	400.	0.	0.	
400.	400.	0.	0.	
400.	400.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	
200.	200.	0.	0.	

41	41	0	1
41	41	0	2
41	41	0	3
41	41	0	4
41	41	0	5
41	41	0	6
1	81		
1	81		
5	5		
4	4		
	0.0	600.0	840.0

SAMPLE OUTPUT FOR PROBLEM # 12-A(Fabrication Load)

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SYNUMCF OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

TIME 600.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	0.307E-02	-0.353E-04	-0.145E-02	0.152E-02	-0.301E-02	0.350E-04

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 12-B (External Load)

FILE: SYNUMCF1 DEMO A1 VM/SP CONVERSATIONAL MONITOR

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.323E+04	0.962E+03	0.000E+00	0.966E+03	-0.505E+01	0.142E+02
2	-0.501E+04	0.181E+04	0.000E+00	0.145E+03	-0.139E+02	-0.292E+02
3	-0.506E+04	0.179E+04	0.000E+00	-0.154E+04	-0.292E+02	0.139E+02
4	-0.171E+02	-0.599E+03	0.000E+00	0.975E+03	-0.142E+02	-0.505E+01

NODE # 5

MICROSTRESSES (in psi. units) IN PLY NO. 4 AT TIME 600.0000000

NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY
1	N0FS	0.7000E+01	N0MS	0.1900E+02	N0DS	0.1300E+02	N0LS	0.7000E+01
2	SIGF11	-0.2231E+05	SIGM11A	0.1480E+05	SIGD11B	0.1369E+04	SIGL11	-0.1709E+02
3	SIGF22	-0.1491E+05	SIGM22A	0.2400E+05	SIGD22B	0.3035E+04	SIGL22	-0.5989E+02
4	SIGF12	0.6964E+04	SIGM22B	0.1953E+05	SIGD22C	-0.1910E+04	SIGL33	0.0000E+00
5	SIGF23	-0.3759E+02	SIGM22C	-0.1491E+05	SIGD12B	0.3720E+03	SIGL12	0.9754E+03
6	SIGF13	-0.1013E+03	SIGM12A	0.5778E+03	SIGD12C	0.4348E+03	SIGL23	-0.1420E+02
7	SIGF33	-0.1413E+05	SIGM12B	0.1033E+04	SIGD23B	-0.1835E+01	SIGL13	-0.5048E+01
8			SIGM12C	0.1202E+04	SIGD23C	-0.2146E+01		
9			SIGM23A	-0.3105E+01	SIGD13B	-0.5405E+01		
10			SIGM23B	-0.5571E+01	SIGD13C	-0.6321E+01		
11			SIGM23C	-0.6483E+01	SIGD33B	0.3109E+04		
12			SIGM13A	-0.8387E+01	SIGD33C	-0.1827E+04		
13			SIGM13B	-0.1507E+02	SIGD11C	0.1369E+04		
14			SIGM13C	-0.1757E+02				
15			SIGM33A	0.2434E+05				
16			SIGM33B	0.2021E+05				
17			SIGM33C	-0.1413E+05				
18			SIGM11B	0.1480E+05				
19			SIGM11C	0.1480E+05				

TIME REQUIRED TO CARRY OUT THE ANALYSIS 350.327 SEC.

TIME REQUIRED TO : READ IN DATA 0.033 SEC.
 DO PREPROCESSING 0.049 SEC.

TITLE=PROBLEM #12B,MODAL & LOAD STEPPING(SENSITIVITY)ANALYSIS FOR CUR
 TITLE=PANEL(20 deg. SHELL ROOF),FIXED STRAIGHT EDGES,FREE CURVED EDGE
 TITLE=EXTERNAL PRESSURE(2000 PSI),UNIFORM TEMP. of 1000 F(REF. TEMP.
 TITLE=F),R=6",W=2",T=.125",4(0/45/-45/90)PLIES,FVR=.4,8X8 MESH,
 TITLE=FABRICATION EFFECTS INCLUDED, NO FIBER DEGRADATION EFFECTS.

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 12-B (CONTINUED)

FILE: SYNUMCF1 DEMO A1

VM/SP CONVERSATIONAL MONITOR

SPLATE
 PLATE
 PRESSURE
 RESTART
 TEMPERATURE
 PLYORDER
 UNSYMMETRICAL
 ENDOPTION

```

4
2
4 9 9 4
  0. 2.
2
2
10 1 1 1 10 10
  7.0
0
0
11
5 5
8
0. -1.0420 5.9100 0.1250
0. -0.5230 5.9775 0.1250
0. 0. 6.0000 0.1250
0. 0.5230 5.9775 0.1250
0. 1.0420 5.9100 0.1250
0
2. -1.0420 5.9100 0.1250
2. -0.5230 5.9775 0.1250
2. 0. 6.0000 0.1250
2. 0.5230 5.9775 0.1250
2. 1.0420 5.9100 0.1250
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 0.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 45.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 -45.0
0.0 100.0 0.0 100.0 0.0 100.0
SICA TI15 0.03125 0.0 0.40 90.0
4 3
1 2
0. 120. 240. 360. 480. 600. 660
780. 840.
```

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 12-B (CONTINUED)

FILE: SYNUMCF1	DEMO	A1	VM/SP CONVERSATIONAL MONITOR
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	00.
70.	70.	00.0	500.
70.	70.	00.0	500.
70.	70.	00.0	500.
70.	70.	00.0	500.
70.	70.	00.0	500.
70.	70.	00.0	500.
70.	70.	00.0	500.
70.	70.	00.0	500.
70.	70.	00.0	500.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
380.	380.	000.0	1000.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
690.	690.	00.0	1500.
1000.	1000.	000.0	2000.
1000.	1000.	000.0	2000.
1000.	1000.	000.0	2000.
1000.	1000.	000.0	2000.
1000.	1000.	000.0	2000.

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 12-B (CONTINUED)

FILE: SYNUMCF1	DEMO	A1	VM/SP CONVERSATIONAL MONITOR
1000.	1000.	000.0	2000.
1000.	1000.	000.0	2000.
1000.	1000.	000.0	2000.
1000.	1000.	000.0	2000.
1000.	1000.	000.0	2000.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
1000.	1000.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
800.	800.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
600.	600.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
400.	400.	0.	0.
200.	200.	0.	0.
200.	200.	0.	0.

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 12 (BYE TOTAL LOSS)

200.	200.	0.	0.
200.	200.	0.	0.
200.	200.	0.	0.
200.	200.	0.	0.
200.	200.	0.	0.
200.	200.	0.	0.
200.	200.	0.	0.
200.	200.	0.	0.

1	73	9	2
1	73	9	3
1	73	9	4
1	73	9	5
1	73	9	6
9	81	9	2
9	81	9	3
9	81	9	4
9	81	9	5
9	81	9	6
37	45	8	1
1	81		
1	81		
5	5		
4	4		
0.0	600.0	840.0	

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SYMUMCF1 OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

TIME 660.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	0.295E-02	-0.334E-04	-0.573E-02	0.157E-02	-0.422E-02	-0.229E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	0.522E+04	0.230E+04	0.000E+00	0.772E+03	-0.319E+02	0.636E+02
2	-0.823E+04	0.199E+03	0.000E+00	0.252E+04	-0.481E+02	-0.145E+03
3	-0.147E+05	-0.526E+04	0.000E+00	-0.775E+04	-0.145E+03	0.481E+02
4	0.109E+04	-0.219E+05	0.000E+00	0.134E+04	-0.636E+02	-0.319E+02

HITCAN Demonstration Manual - Version I.0
 SAMPLE OUTPUT FOR PROBLEM # 12-B (CONTINUED)

NODE # 5		MICROSTRESSES (in psi. units)						
NO.	STRESS	FIBER	IN PLY NO.	4 AT TIME	660.0000000	INTERFACE	STRESS	PLY
			STRESS	MATRIX	STRESS			
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	-0.1235E+05	SIGM11A	0.1002E+05	SIGD11B	0.6363E+04	SIGL11	0.1094E+04
3	SIGF22	-0.3954E+05	SIGM22A	0.1059E+05	SIGD22B	-0.2378E+05	SIGL22	-0.2194E+05
4	SIGF12	0.9252E+04	SIGM22B	-0.4278E+04	SIGD22C	-0.2464E+05	SIGL33	0.0000E+00
5	SIGF23	-0.2220E+03	SIGM22C	-0.3954E+05	SIGD12B	0.1180E+04	SIGL12	0.1341E+04
6	SIGF13	-0.4115E+03	SIGM12A	0.7993E+03	SIGD12C	0.1377E+04	SIGL23	-0.6363E+02
7	SIGF33	-0.1478E+05	SIGM12B	0.1414E+04	SIGD23B	-0.9427E+02	SIGL13	-0.3187E+02
8			SIGM12C	0.1648E+04	SIGD23C	-0.1102E+03		
9			SIGM23A	-0.2085E+02	SIGD13B	-0.1588E+03		
10			SIGM23B	-0.3644E+02	SIGD13C	-0.1857E+03		
11			SIGM23C	-0.4258E+02	SIGD33B	-0.4337E+03		
12			SIGM13A	-0.3826E+02	SIGD33C	-0.6762E+03		
13			SIGM13B	-0.6708E+02	SIGD11C	0.6351E+04		
14			SIGM13C	-0.7839E+02				
15			SIGM33A	0.2476E+05				
16			SIGM33B	0.1977E+05				
17			SIGM33C	-0.1478E+05				
18			SIGM11B	0.1002E+05				
19			SIGM11C	0.1002E+05				

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SYNUMCF1 OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

TIME 720.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	0.163E-02	-0.356E-04	-0.597E-02	0.160E-02	-0.316E-02	-0.247E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.221E+05	0.362E+04	0.000E+00	0.797E+03	-0.676E+02	0.400E+02
2	-0.193E+05	-0.882E+04	0.000E+00	0.113E+05	0.419E+02	-0.163E+03
3	-0.273E+05	-0.156E+05	0.000E+00	-0.165E+05	-0.163E+03	-0.419E+02
4	0.394E+04	-0.419E+05	0.000E+00	0.147E+04	-0.400E+02	-0.676E+02

NODE # 5
 MICROSTRESSES (in psi. units) IN PLY NO. 4 AT TIME 720.0000000

NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	0.1033E+05	SIGM11A	-0.3432E+03	SIGD11B	0.6402E+04	SIGL11	0.3939E+0

HITSCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 1 (CONTINUED)

3	SIGF22	-0.5688E+05	SIGM22A	-0.9809E+04	SIGD22B	-0.2654E+05	SIGL22	-0.4189E+05
4	SIGF12	0.1011E+05	SIGM22B	-0.3082E+05	SIGD22C	-0.1738E+05	SIGL33	0.0000E+00
5	SIGF23	-0.4955E+03	SIGM22C	-0.5688E+05	SIGD12B	0.4364E+03	SIGL12	0.1466E+04
6	SIGF13	-0.2499E+03	SIGM12A	0.8740E+03	SIGD12C	0.5074E+03	SIGL23	-0.3996E+02
7	SIGF33	-0.1087E+05	SIGM12B	0.1543E+04	SIGD23B	-0.1372E+03	SIGL13	-0.6762E+02
8			SIGM12C	0.1805E+04	SIGD23C	-0.1602E+03		
9			SIGM23A	-0.4456E+02	SIGD13B	0.8131E+02		
10			SIGM23B	-0.7864E+02	SIGD13C	0.9493E+02		
11			SIGM23C	-0.9191E+02	SIGD33B	-0.7489E+04		
12			SIGM13A	-0.2422E+02	SIGD33C	0.3933E+04		
13			SIGM13B	-0.4206E+02	SIGD11C	0.6515E+04		
14			SIGM13C	-0.4917E+02				
15			SIGM33A	0.1731E+05				
16			SIGM33B	0.1231E+05				
17			SIGM33C	-0.1087E+05				
18			SIGM11B	-0.3432E+03				
19			SIGM11C	-0.3432E+03				

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SYNUMCF1 OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001
 TIME 780.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	0.206E-03	-0.383E-04	-0.645E-02	0.165E-02	-0.184E-02	-0.306E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.493E+05	0.530E+04	0.000E+00	0.773E+03	-0.992E+02	0.147E+02
2	-0.299E+05	-0.177E+05	0.000E+00	0.197E+05	0.128E+03	-0.173E+03
3	-0.395E+05	-0.259E+05	0.000E+00	-0.246E+05	-0.173E+03	-0.128E+03
4	0.727E+04	-0.607E+05	0.000E+00	0.161E+04	-0.147E+02	-0.992E+02

NODE # 5

MICROSTRESSES (in psi. units) IN PLY NO. 4 AT TIME 780.0000000

NO.	STRESS FIBER	STRESS MATRIX	STRESS INTERFACE	STRESS PLY
1	NOFS 0.7000E+01	NOMS 0.1900E+02	NODS 0.1300E+02	NOLS 0.7000E+01
2	SIGF11 0.3750E+05	SIGM11A -0.1293E+05	SIGD11B 0.9032E+04	SIGL11 0.7265E+04
3	SIGF22 -0.7285E+05	SIGM22A -0.2887E+05	SIGD22B -0.2377E+05	SIGL22 -0.6066E+05
4	SIGF12 0.1116E+05	SIGM22B -0.5457E+05	SIGD22C -0.1595E+05	SIGL33 0.0000E+00
5	SIGF23 -0.7850E+03	SIGM22C -0.7285E+05	SIGD12B 0.5285E+03	SIGL12 0.1605E+04
6	SIGF13 -0.5690E+02	SIGM12A 0.9554E+03	SIGD12C 0.6120E+03	SIGL23 -0.1472E+02
7	SIGF33 -0.6704E+04	SIGM12B 0.1689E+04	SIGD23B -0.1426E+03	SIGL13 -0.9917E+02
8		SIGM12C 0.1972E+04	SIGD23C -0.1659E+03	

HITCAN Demonstration Manual - Version I.0

9	SIGM23A	-0.6674E+02	SIGD13B	0.9491E+02
10	SIGM23B	-0.1191E+03	SIGD13C	0.1104E+03
11	SIGM23C	-0.1390E+03	SIGD33B	-0.6906E+04
12	SIGM13A	-0.9462E+01	SIGD33C	0.4196E+04
13	SIGM13B	-0.1516E+02	SIGD11C	0.9132E+04
14	SIGM13C	-0.1786E+02		
15	SIGH33A	0.9303E+04		
16	SIGH33B	0.5393E+04		
17	SIGH33C	-0.6704E+04		
18	SIGM11B	-0.1293E+05		
19	SIGM11C	-0.1293E+05		

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 0 DEG. AT TOP)

FILE: SYNUNCF1 OUT A VM/SP CONVERSATIONAL MONITOR SYSTEM PAGE 00001

TIME 840.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
5	-0.115E-02	-0.465E-04	-0.795E-02	0.165E-02	0.909E-03	-0.441E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 5

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.642E+05	0.759E+04	0.000E+00	0.530E+03	-0.660E+02	-0.273E+02
2	-0.382E+05	-0.273E+05	0.000E+00	0.275E+05	0.142E+03	-0.586E+02
3	-0.545E+05	-0.405E+05	0.000E+00	-0.334E+05	-0.586E+02	-0.142E+03
4	0.127E+05	-0.757E+05	0.000E+00	0.224E+04	0.273E+02	-0.660E+02

NODE # 5

MICROSTRESSES (in psi. units)	IN PLY NO.	4 AT TIME	840.0000000	STRESS	INTERFACE	STRESS	PLY	
NO.	STRESS	FIBER	STRESS	MATRIX				
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	0.8461E+05	SIGM11A	-0.3527E+05	SIGD11B	0.1007E+05	SIGL11	0.1269E+05
3	SIGF22	-0.6676E+05	SIGM22A	-0.5220E+05	SIGD22B	-0.3104E+05	SIGL22	-0.7572E+05
4	SIGF12	0.1682E+05	SIGM22B	-0.8544E+05	SIGD22C	0.6036E+04	SIGL33	0.0000E+00
5	SIGF23	-0.2278E+03	SIGM22C	0.0000E+00	SIGD12B	0.2743E+04	SIGL12	0.2240E+04
6	SIGF13	0.3173E+03	SIGM12A	0.1318E+04	SIGD12C	0.3155E+04	SIGL23	0.2734E+02
7	SIGF33	-0.1689E+04	SIGM12B	0.2377E+04	SIGD23B	0.2683E+03	SIGL13	-0.6605E+02
8			SIGM12C	0.2759E+04	SIGD23C	0.3099E+03		
9			SIGM23A	-0.3097E+02	SIGD13B	0.1802E+03		
10			SIGM23B	-0.5125E+02	SIGD13C	0.2082E+03		
11			SIGM23C	-0.6073E+02	SIGD33B	-0.1010E+05		
12			SIGM13A	0.1453E+02	SIGD33C	0.5011E+04		

HITCAN Demonstration Manual - Version I.0
SAMPLE OUTPUT FOR PROBLEM # 12-B (CONTINUED)

13	SIGN13B	0.3030E+02	SIGD11C	0.1045E+05
14	SIGN13C	0.3467E+02		
15	SIGN33A	-0.4089E+03		
16	SIGN33B	-0.4714E+04		
17	SIGN33C	-0.1689E+04		
18	SIGN11B	-0.3527E+05		
19	SIGN11C	-0.3527E+05		

TIME REQUIRED TO CARRY OUT THE ANALYSIS 276.556 SEC.

TIME REQUIRED TO : READ IN DATA 0.833 SEC.
DO PREPROCESSING 0.849 SEC.

DEMONSTRATION PROBLEM NO. 13

PROBLEM TYPE:

Load stepping analysis of a hollow sandwich type built-up structure using plate element subjected to thermo-mechanical loading including fabrication load history.

PROBLEM DESCRIPTION:

A hollow built-up structure of 0.5" length, 0.2" width, 0.075" total thickness, 0.02" thickness of top plate, 0.01" thickness of bottom plate, and 3 spars in the x-z plane equally spaced in the y-direction with 0.02" thickness the z-direction, with bottom surface fixed in vertical direction, is subjected to 4 load steps of internal pressure (0-2000 psi) and uniform temperature increase (70-1000 F). The built-up structure is made of Sic/Ti-15-3-3-3 composite material (Silicon Carbide fiber, Titanium matrix with 15% Vanadium, 3% Aluminum, 3% Chromium, and 3% Tin, and interphase with average properties of fiber and matrix). The composite laminate consists of 4 (90/0/0/90) plies of equal thickness for the top plate, 2 (90/90) plies of equal thickness for the bottom plate, and 4 (0/0/0/0) plies of equal thickness for the spars, all with 0.4 fiber volume ratio. The ply lay-up is symmetric for all parts of the structure. The ply lay-up is same as that used for problem # 5 shown on pages 33-34. The material properties at the reference temperature of 70 F are listed in Table II. The exponents for material property variations according to the nonlinear multi-factor interaction model (Ref. 1) are listed in Table III. Results are to be generated for the displacement and stress responses at each load step including the fabrication load history accounting for the nonlinear material behavior. The geometry, boundary conditions, loading, and ply lay-up are shown in the figure on next page.

MODELING HINTS:

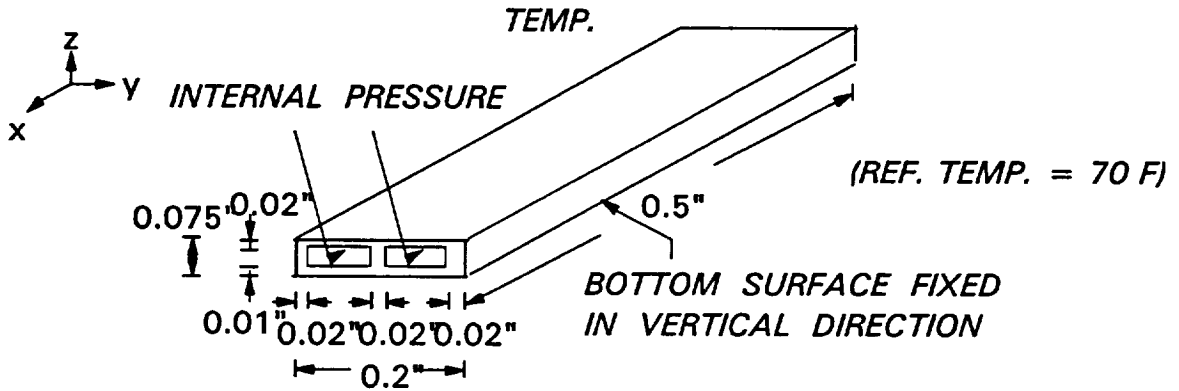
The finite element mesh consists of 4 elements in the x-direction and 8 in the y-direction for both the top and bottom plates and 4 elements in the x-direction and 1 element in the z-direction for all each of the 3 spars. The mesh is same as that used for problem # 5 shown on pages 35-36. The material property data file, "DATA BANK" is included in Appendix 1.

PROBLEM # 13

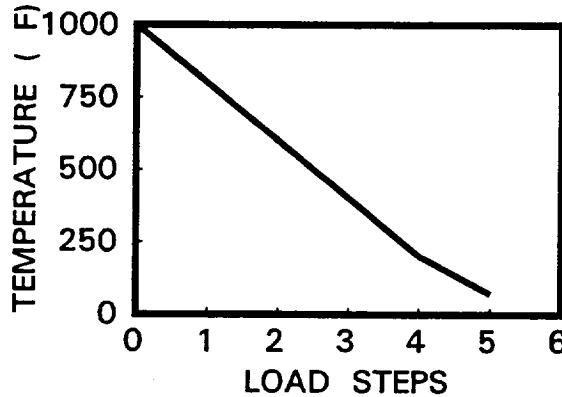
BOTTOM SUPPORTED BUILT-UP STRUCTURE UNDER BENDING & UNIFORM TEMP. LOADINGS FOLLOWED BY FABRICATION THERMAL COOLING LOAD

FOR (Si C/Ti-15-3-3-3, TOP:[90,0]_s, BOTTOM:[90]_s, SPARS:4[0]_s); 0.4 FIBER VOLUME RATIO

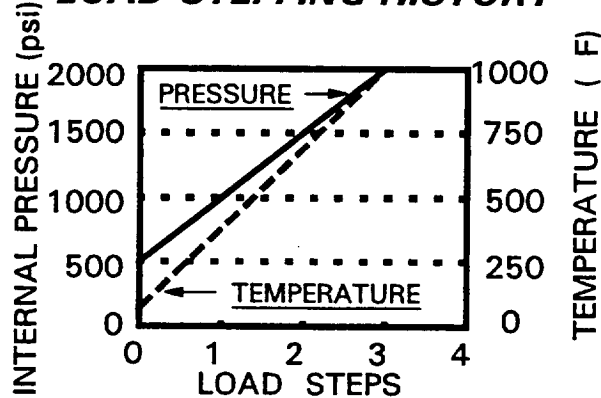
GEOMETRY, BOUNDARY CONDITIONS, AND LOADING



FABRICATION THERMAL COOLING LOAD HISTORY



LOAD STEPPING HISTORY



HITCAN Demonstration Manual - Version 1.0

INPUT DECK SETUP FOR PROBLEM # 13-A (Fabrication Load)

FILE: UYNUMCF DEMO A1

VM/SP CONVERSATIONAL MONITOR

TITLE=PROB # 13-A,PANEL,BOTTOM FIXED IN Z-DIRECTION+,INSIDE AT 1000F&
 TITLE=2000 psi, OUTSIDE AT 1000F & 0 PSI,4X8(TOP)-8(BOT)-12(SPARE)MESH
 TITLE=3 SPARS-.02" THICK-4(1,-1,-1,1)PLY TYPE,TOP-.02"-4(1,2,2,1)PLIE
 TITLE=BOTTOM-.01"-2(2,2)PLIES,L=.5",W=.2",H=.075",LINC=2
 TITLE=FABRICATION(1000 TO 70 F),NO FIBER DEGRADATION.

HPLATE
 PLATE
 FABRICATION
 PROFILE
 PLYORDER
 TEMPERATURE
 PRESSURE
 PANEL
 ENDOPTION

2						
2	2	3	7			
2						
3	3					
10	1	1	1	5	10	
	1.0					
0						
0						
6						
1	1	1				
2	0.00					
	0.000	.02	0.000	.02	0.000	.02
2	0.25					
	0.000	.02	0.000	.02	0.000	.02
	0.50					
	0.000	.02	0.000	.02	0.000	.02
3	3	3				
3	3	3				
	0.0000	-0.1000	0.0400	0.0200		
	0.0000	0.0000	0.0400	0.0200		
	0.0000	0.1000	0.0400	0.0200		
	0.2500	-0.1000	0.0400	0.0200		
	0.2500	0.0000	0.0400	0.0200		
	0.2500	0.1000	0.0400	0.0200		
	0.5000	-0.1000	0.0400	0.0200		
	0.5000	0.0000	0.0400	0.0200		
	0.5000	0.1000	0.0400	0.0200		
	0.0000	-0.1000	-0.0350	0.0100		
	0.0000	0.0000	-0.0350	0.0100		
	0.0000	0.1000	-0.0350	0.0100		
	0.2500	-0.1000	-0.0350	0.0100		
	0.2500	0.0000	-0.0350	0.0100		
	0.2500	0.1000	-0.0350	0.0100		
	0.5000	-0.1000	-0.0350	0.0100		
	0.5000	0.0000	-0.0350	0.0100		
	0.5000	0.1000	-0.0350	0.0100		

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 13-A (CONTINUED)

FILE: UYNUMCF DEMO A1 VM/SP CONVERSATIONAL MONITOR

690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
41	41	0	1
41	41	0	2
41	41	0	3
41	41	0	4
41	41	0	5
41	41	0	6
1	12		
1	12		
3	3	12	12
4	4		
0.	600.	840.	

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 13-A(Fabrication Load)

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

FILE: UYNUMCF OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

TIME 600.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	0.781E-03	0.150E-03	0.220E-03	-0.104E-03	-0.199E-03	-0.273E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.406E+04	0.381E+04	0.000E+00	0.127E+03	0.102E+02	-0.105E+01
2	-0.268E+04	0.307E+04	0.000E+00	-0.111E+03	0.224E+01	0.218E+02
3	-0.262E+04	0.297E+04	0.000E+00	-0.943E+02	0.224E+01	0.218E+02
4	-0.468E+04	0.386E+04	0.000E+00	0.779E+02	0.102E+02	-0.105E+01

INODE # 3

MICROSTRESSES (in psi. units)

NO.	STRESS	FIBER	IN PLY NO. STRESS	4 AT TIME MATRIX	600.0000000 STRESS	INTERFACE	STRESS	PLY
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	-0.3356E+05	SIGM11A	0.1462E+05	SIGD11B	0.5669E+03	SIGL11	-0.4681E+04
3	SIGF22	-0.9195E+04	SIGM22A	0.2650E+05	SIGD22B	0.3588E+04	SIGL22	0.3864E+04
4	SIGF12	0.5546E+03	SIGM22B	0.2439E+05	SIGD22C	-0.1245E+04	SIGL33	0.0000E+00
5	SIGF23	-0.7757E+01	SIGM22C	-0.9195E+04	SIGD12B	0.3198E+02	SIGL12	0.7786E+02
6	SIGF13	0.7282E+02	SIGM12A	0.4602E+02	SIGD12C	0.3743E+02	SIGL23	0.1017E+02
7	SIGF33	-0.1401E+05	SIGM12B	0.8257E+02	SIGD23B	-0.4226E+00	SIGL13	-0.1047E+01
8			SIGM12C	0.9625E+02	SIGD23C	-0.4942E+00		
9			SIGM23A	-0.6435E+00	SIGD13B	0.3689E+01		
10			SIGM23B	-0.1158E+01	SIGD13C	0.4314E+01		
11			SIGM23C	-0.1342E+01	SIGD33B	0.3119E+04		
12			SIGM13A	0.6014E+01	SIGD33C	-0.1813E+04		
13			SIGM13B	0.1080E+02	SIGD11C	0.5661E+03		
14			SIGM13C	0.1261E+02				
15			SIGM33A	0.2423E+05				
16			SIGM33B	0.2032E+05				
17			SIGM33C	-0.1401E+05				
18			SIGM11B	0.1462E+05				
19			SIGM11C	0.1462E+05				

TIME REQUIRED TO CARRY OUT THE ANALYSIS 451.148 SEC.

TIME REQUIRED TO : READ IN DATA 0.054 SEC.

DO PREPROCESSING 0.232 SEC.

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 13-B (External Load)

FILE: UYNUMCF1 DEMO A1

VM/SP CONVERSATIONAL MONITOR

TITLE=PROB # 13-B,PANEL,BOTTOM FIXED IN Z-DIRECTION+,INSIDE AT 1000F&
 TITLE=2000 psi, OUTSIDE AT 1000F & 0 PSI,4X8(TOP)-8(BOT)-12(SPAN)MESH
 TITLE=3 SPARS-.02" THICK-4(1,-1,-1,1)PLY TYPE, TOP-.02"-4(1,2,2,1)PLIE
 TITLE=BOTTOM-.01"-2(2,2)PLIES,L=.5",W=.2",H=.075",LINC=2
 TITLE=FABRICATION(1000 TO 70 F),NO FIBER DEGRADATION. ION,
 HPLATE
 PLATE
 FABRICATION
 RESTART
 PROFILE
 PLYORDER
 TEMPERATURE
 PRESSURE
 PANEL
 ENDOPTION

2						
2	2	3	7			
2						
3	3					
10	1	1	1	10	10	
	1.0					
0						
0						
8						
1	1	1				
2	0.00					
	0.000	.02	0.000	.02	0.000	.02
2	0.25					
	0.000	.02	0.000	.02	0.000	.02
	0.50					
	0.000	.02	0.000	.02	0.000	.02
3	3	3				
3	3	3				
	0.0000	-0.1000	0.0400	0.0200		
	0.0000	0.0000	0.0400	0.0200		
	0.0000	0.1000	0.0400	0.0200		
	0.2500	-0.1000	0.0400	0.0200		
	0.2500	0.0000	0.0400	0.0200		
	0.2500	0.1000	0.0400	0.0200		
	0.5000	-0.1000	0.0400	0.0200		
	0.5000	0.0000	0.0400	0.0200		
	0.5000	0.1000	0.0400	0.0200		
	0.0000	-0.1000	-0.0350	0.0100		
	0.0000	0.0000	-0.0350	0.0100		
	0.0000	0.1000	-0.0350	0.0100		
	0.2500	-0.1000	-0.0350	0.0100		
	0.2500	0.0000	-0.0350	0.0100		
	0.2500	0.1000	-0.0350	0.0100		
	0.5000	-0.1000	-0.0350	0.0100		
	0.5000	0.0000	-0.0350	0.0100		
	0.5000	0.1000	-0.0350	0.0100		

HITCAN Demonstration Manual - Version I.0
 INPUT DECK SETUP FOR PROBLEM # 13-B (CONTINUED)

FILE: UYNUMCF1 DEMO A1 VM/SP CONVERSATIONAL MONITOR

690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	0.	1500.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
690.	690.	1500.	00.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	0.	2000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
1000.	1000.	2000.	000.
37	46	9	1
45	54	9	1
41	50	9	2
10	18	1	3
28	36	1	3
46	54	1	3
64	72	1	3
82	90	1	3
1	12		
1	12		
3	3	12	12
4	4		
0.	600.	840.	

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 13-B(External Load)

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

FILE: UYNUMCF1 OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

TIME 660.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	0.783E-03	0.150E-03	0.220E-03	-0.124E-03	-0.191E-03	-0.306E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.629E+04	0.349E+04	0.000E+00	0.163E+03	0.725E+02	-0.597E+01
2	-0.284E+04	0.273E+04	0.000E+00	-0.136E+03	0.128E+02	0.155E+03
3	-0.268E+04	0.360E+04	0.000E+00	-0.109E+03	0.128E+02	0.155E+03
4	-0.193E+04	0.409E+04	0.000E+00	0.821E+02	0.725E+02	-0.597E+01

NODE # 3

MICROSTRESSES (in psi. units) IN PLY NO. 4 AT TIME 660.0000000

NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	-0.2849E+05	SIGM11A	0.1578E+05	SIGD11B	0.3071E+04	SIGL11	-0.1928E+04
3	SIGF22	-0.8880E+04	SIGM22A	0.2662E+05	SIGD22B	0.2375E+03	SIGL22	0.4093E+04
4	SIGF12	0.5817E+03	SIGM22B	0.2465E+05	SIGD22C	0.3204E+03	SIGL33	0.0000E+00
5	SIGF23	-0.4127E+02	SIGM22C	-0.8880E+04	SIGD12B	0.1365E+02	SIGL12	0.8211E+02
6	SIGF13	0.4645E+03	SIGM12A	0.4857E+02	SIGD12C	0.1597E+02	SIGL23	0.7252E+02
7	SIGF33	-0.1338E+05	SIGM12B	0.8707E+02	SIGD23B	-0.1713E+02	SIGL13	-0.5969E+01
8			SIGM12C	0.1015E+03	SIGD23C	-0.2003E+02		
9			SIGM23A	-0.3867E+01	SIGD13B	0.2002E+03		
10			SIGM23B	-0.6769E+01	SIGD13C	0.2342E+03		
11			SIGM23C	-0.7899E+01	SIGD33B	0.5109E+03		
12			SIGM13A	0.4369E+02	SIGD33C	0.6217E+03		
13			SIGM13B	0.7636E+02	SIGD11C	0.3071E+04		
14			SIGM13C	0.8927E+02				
15			SIGM33A	0.2447E+05				
16			SIGM33B	0.2081E+05				
17			SIGM33C	-0.1338E+05				
18			SIGM11B	0.1578E+05				
19			SIGM11C	0.1578E+05				

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 13-B (Continued)

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

FILE: UYNUMCF1 OUT

A

VH/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

TIME 780.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	0.258E-03	0.497E-04	0.220E-03	-0.154E-03	-0.162E-03	-0.161E-04

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.827E+04	0.336E+03	0.000E+00	0.162E+03	0.220E+03	-0.148E+02
2	-0.109E+04	-0.206E+03	0.000E+00	-0.115E+03	0.318E+02	0.472E+03
3	-0.734E+03	0.272E+04	0.000E+00	-0.679E+02	0.318E+02	0.472E+03
4	0.680E+04	0.194E+04	0.000E+00	0.207E+02	0.220E+03	-0.148E+02

NODE # 3

MICROSTRESSES (in psi. units)

IN PLY NO. 4

AT TIME

780.0000000

NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	0.4844E+04	SIGM11A	0.8080E+04	SIGD11B	0.3196E+04	SIGL11	0.6797E+04
3	SIGF22	-0.2009E+04	SIGM22A	0.8901E+04	SIGD22B	-0.7471E+04	SIGL22	0.1944E+04
4	SIGF12	0.1360E+03	SIGM22B	0.9143E+04	SIGD22C	0.3461E+04	SIGL33	0.0000E+00
5	SIGF23	-0.1073E+03	SIGM22C	-0.2009E+04	SIGD12B	-0.1189E+03	SIGL12	0.2073E+02
6	SIGF13	0.1533E+04	SIGM12A	0.1240E+02	SIGD12C	-0.1378E+03	SIGL23	0.2202E+03
7	SIGF33	-0.2710E+04	SIGM12B	0.2165E+02	SIGD23B	-0.1622E+02	SIGL13	-0.1483E+02
8			SIGM12C	0.2598E+02	SIGD23C	-0.1888E+02		
9			SIGM23A	-0.9249E+01	SIGD13B	0.2717E+03		
10			SIGM23B	-0.1650E+02	SIGD13C	0.3160E+03		
11			SIGM23C	-0.1916E+02	SIGD33B	-0.5747E+04		
12			SIGM13A	0.1308E+03	SIGD33C	0.5490E+04		
13			SIGM13B	0.2330E+03	SIGD11C	0.3198E+04		
14			SIGM13C	0.2726E+03				
15			SIGM33A	0.8593E+04				
16			SIGM33B	0.8553E+04				
17			SIGM33C	-0.2710E+04				
18			SIGM11B	0.8080E+04				
19			SIGM11C	0.8080E+04				

HITCAN Demonstration Manual - Version I.0

SAMPLE OUTPUT FOR PROBLEM # 13-B (Continued)

(NOTE: PLY # 1 IS AT 90 DEG. AT BOTTOM & PLY # 4 IS AT 90 DEG. AT TOP)

FILE: UYNUMCF1 OUT A

VM/SP CONVERSATIONAL MONITOR SYSTEM

PAGE 00001

TIME 840.0000000

TOTAL DISPLACEMENTS FOR SELECTED NODES

NODE NO.	X (in.)	Y (in.)	Z (in.)	THETA-X (rad.)	THETA-Y (rad.)	THETA-Z (rad.)
12	-0.451E-04	-0.771E-05	0.220E-03	-0.169E-03	-0.148E-03	-0.305E-05

PLY STRESSES (in psi. units) IN THE MATERIAL COORDINATE SYSTEM FOR NODE 3

PLY NO.	SIGL-11	SIGL-22	SIGL-33	SIGL-12	SIGL-23	SIGL-31
1	-0.891E+04	-0.156E+04	0.000E+00	0.145E+03	0.299E+03	-0.184E+02
2	0.901E+02	-0.193E+04	0.000E+00	-0.907E+02	0.395E+02	0.641E+03
3	0.448E+03	0.192E+04	0.000E+00	-0.363E+02	0.395E+02	0.641E+03
4	0.117E+05	0.457E+03	0.000E+00	-0.182E+02	0.299E+03	-0.184E+02

NODE # 3

MICROSTRESSES (in psi. units)			IN PLY NO. 4		AT TIME 840.0000000			
NO.	STRESS	FIBER	STRESS	MATRIX	STRESS	INTERFACE	STRESS	PLY
1	NOFS	0.7000E+01	NOMS	0.1900E+02	NODS	0.1300E+02	NOLS	0.7000E+01
2	SIGF11	0.2492E+05	SIGM11A	0.2825E+04	SIGD11B	0.5000E+04	SIGL11	0.1168E+05
3	SIGF22	0.1386E+04	SIGM22A	-0.1018E+04	SIGD22B	-0.6699E+04	SIGL22	0.4575E+03
4	SIGF12	-0.2101E+03	SIGM22B	0.2459E+04	SIGD22C	0.3396E+04	SIGL33	0.0000E+00
5	SIGF23	-0.1385E+03	SIGM22C	0.1386E+04	SIGD12B	-0.1674E+03	SIGL12	-0.1818E+02
6	SIGF13	0.2230E+04	SIGM12A	-0.9795E+01	SIGD12C	-0.1925E+03	SIGL23	0.2989E+03
7	SIGF33	0.3067E+04	SIGM12B	-0.2068E+02	SIGD23B	-0.1519E+02	SIGL13	-0.1844E+02
8			SIGM12C	-0.2263E+02	SIGD23C	-0.1755E+02		
9			SIGM23A	-0.1127E+02	SIGD13B	0.3378E+03		
10			SIGM23B	-0.2034E+02	SIGD13C	0.3900E+03		
11			SIGM23C	-0.2363E+02	SIGD33B	-0.4580E+04		
12			SIGM13A	0.1759E+03	SIGD33C	0.5777E+04		
13			SIGM13B	0.3182E+03	SIGD11C	0.5003E+04		
14			SIGM13C	0.3713E+03				
15			SIGM33A	-0.1657E+03				
16			SIGM33B	0.3970E+04				
17			SIGM33C	0.3067E+04				
18			SIGM11B	0.2825E+04				
19			SIGM11C	0.2825E+04				

TIME REQUIRED TO CARRY OUT THE ANALYSIS 344.972 SEC.

TIME REQUIRED TO : READ IN DATA 0.055 SEC.

DO PREPROCESSING 0.232 SEC.

HITCAN Demonstration Manual - Version I.0

APPENDIX 1

(MATERIAL PROPERTY DATA BANK FILES)

Appedix

March, 1992

APPEND1

HITCAN Demonstration Manual - Version I.0

MATERIAL PROPERTIES DATA FOR STATIC ANALYSIS (CONTINUED)
 (ZERO EXPONENTS FOR SICA & TI15 MATERIALS)

FILE: DATAS BANK A1 VM/SP CONVERSATIONAL MONITOR SYSTEM

2

P100/COPR 10-26-79 NO REF.

21	9	9	30						
70.0	4290.0	1000000.		.199	61350000.	9300000.	3404396.	3404196.	
.25	.275	.155		13.4	10.52	.0000045	.0000105	341000.0	
116000.0	41000.0	28500.0		22000.0	15750.0				
.0	.0	.0		.0	.0	.0	.0	.0	
.0	.0	.0		.0	.0	.0	.0	.0	
.0	.0	.0		.0	.0	.0	.0	.0	
.5	2.	.5		.5	.0	.5	.5	.5	
.5	.5	.0		.5	.5	.0	.5	.5	
.0	.5	.5		.5	.5	.5	.5	.5	
.5	.5	.5		.5	.5	.5	.5	.5	

SICA/TI15 10-26-79 NO REF.

21	9	9	30						
70.0	3335.0	1000000.		.141	37150000.	37150000.	14229546.	14229456.	
.31	.31	.205		.57	.57	.0000032	.0000032	315000.0	
390000.0	315000.0	390000.0		195500.0	195500.0				
.0	.0	.0		.0	.0	.0	.0	.0	
.0	.0	.0		.0	.0	.0	.0	.0	
.0	.0	.0		.0	.0	.0	.0	.0	
.5	.5	.5		.5	.0	.5	.5	.5	
.5	.5	.5		.5	.5	.5	.5	.5	
.5	.5	.5		.5	.5	.5	.5	.5	
.5	.5	.5		.5	.5	.5	.5	.5	
70.	1.	1.		1.	1.	70000.			

/EOF

HITCAN Demonstration Manual - Version I.0

MATERIAL PROPERTIES DATA FOR NONLINEAR ANALYSIS (CONTINUED)
(NONZERO EXPONENTS)

FILE: DATA BANK A1 VM/SP CONVERSATIONAL MONITOR SYSTEM

2

P100/COPR 10-26-79 NO REF.

21	9	9	30						
70.0	4290.0	1000000.	.199	61350000.	9300000.	3404396.	3404196.		
.25	.275	.155	13.4	10.52	.0000045	.0000105	341000.0		
116000.0	41000.0	28500.0	22000.0	15750.0					
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0									
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0									
.5	2.	.5	.5	.0	.5	.5	.5	.5	.5
.5	.5	.0	.5	.5	.0	.5	.5	.5	.5
.0	.5	.5	.5	.5	.5	.5	.5	.5	.5
.5	.5	.5	.5	.5	.5	.5			

SICA/II15 10-26-79 NO REF.

21	9	9	30						
70.0	3335.0	1000000.	.141	37150000.	37150000.	14229546.	14229456.		
.31	.31	.205	.57	.57	.0000032	.0000032	315000.0		
390000.0	315000.0	390000.0	195500.0	195500.0					
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0									
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0									
.5	.5	.5	.5	.0	.5	.5	.5	.5	.5
.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
.5	.5	.5	.5	.5	.5	.5			
70.	1.	1.	1.	1.	1.	70000.			

/EOF



HITCAN Demonstration Manual - Version I.0

APPENDIX 2

(HITCAN EXECUTION FILES)

HITCAN Demonstration Manual - Version I.0

FILE FOR HITCAN EXECUTION ON NASA LERC CRAY-XMP
(fill in the appropriate filename & filetype for the problem
to be run. Also, use the appropriate name for data bank file.)

FILE: DEMOX NQS A1 VM/SP CONVERSATIONAL MONITOR

```
# USER=smxxxx PW=xxxxxxxx
# QSUB-r filename
# QSUB -lT 60
# QSUB -lM 2.0Mw
# QSUB-eo
set -x
  fetch data -t'fn=filename,ft=filetype'      # input file
#fetch restar -t'fn=filename,ft=restart'      # restart file
#cat restar >>data
touch t7 t8 t10 t11 t12 t18 t19 t50 t54 t70
touch t57 t59 t61 t63 t66 t67 t68 t76 t77 t78 t79 t93 t95 t96
ln t6 fort.6
ln t7 fort.7
ln t8 fort.8
ln t10 fort.10
ln t11 fort.11
ln t12 fort.12
ln t18 fort.18
ln t19 fort.19
ln t50 fort.50
ln t54 fort.54
ln t57 fort.57
ln t59 fort.59
ln t61 fort.61
ln t63 fort.63
ln t66 fort.66
ln t67 fort.67
ln t68 fort.68
ln t70 fort.70
ln t76 fort.76
ln t77 fort.77
ln t78 fort.78
ln t79 fort.79
ln t93 fort.93
ln t95 fort.95
ln t96 fort.96
fetch t70 -t'fn=data,ft=bank'      # data bank
jad
$HOME/htcan < data# compiled code
jar -a
#dispose t18 -t'fn=filename,ft=model'
#dispose t77 -t'fn=tran,ft=file'
dispose t68 -t'fn=filename,ft=restart'
#dispose t76 -t'fn=filename,ft=disp'
#dispose t93 -t'fn=for,ft=file'
#dispose t66 -t'fn=met,ft=file'
#dispose t50 -t'fn=t50,ft=file'
rm core fort* tmp* data t*
exit
```

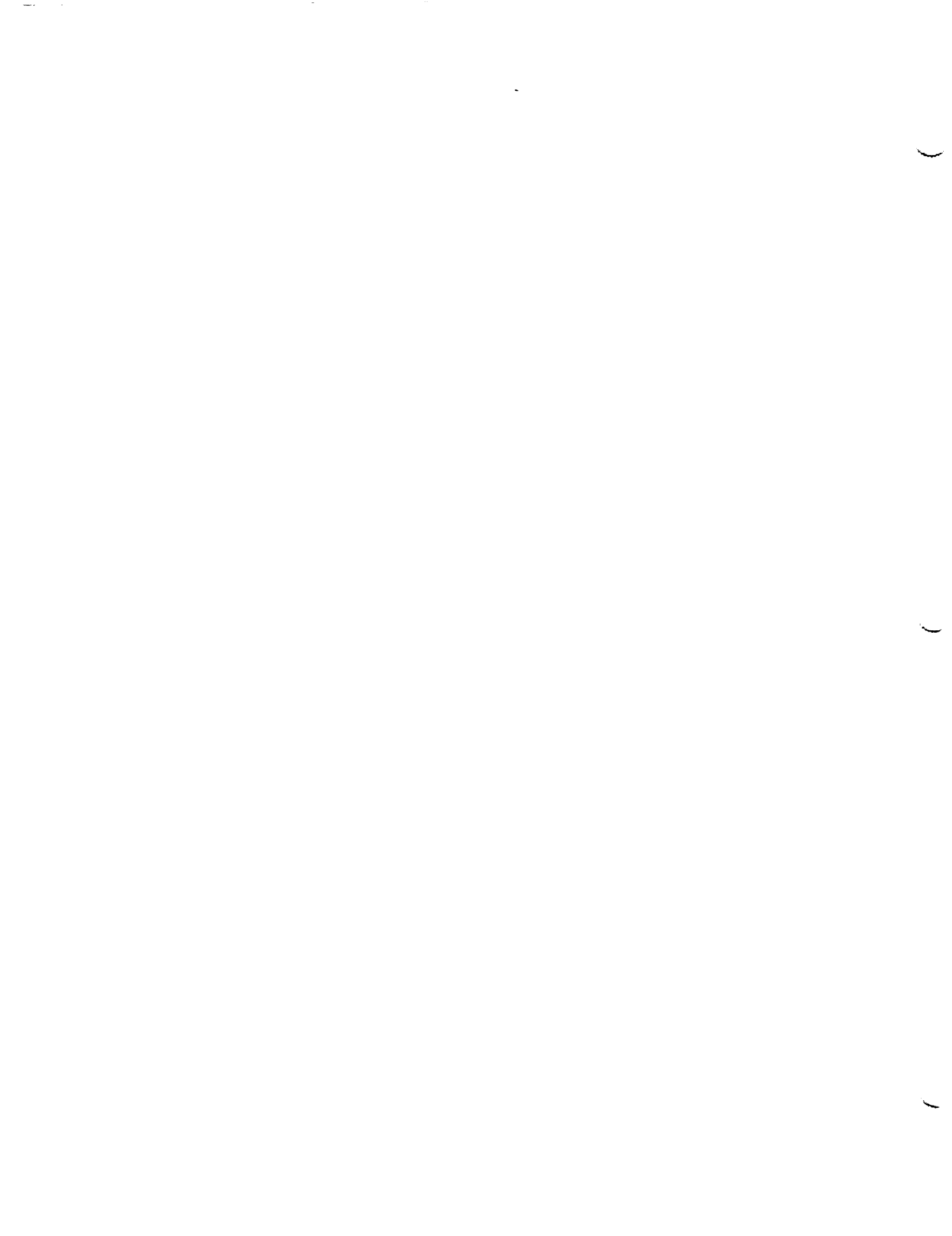
HITCAN Demonstration Manual - Version I.0

FILE FOR HITCAN EXECUTION ON NASA LERC CRAY-YMP

(fill in the appropriate filename & filetype for the problem to be run. Also, use the appropriate name for data bank file.)

FILE: DEMOY NQS A1 VM/SP CONVERSATIONAL MONITOR

```
# QSUB-r filename
# QSUB -lT 100
# QSUB -lM 2.0Mw
# QSUB-eo
cd $W
set -x
#cat restar >>data
touch t7 t8 t10 t11 t12 t18 t19 t50 t54 t70
touch t57 t59 t61 t63 t66 t67 t68 t76 t77 t78 t79 t93 t95 t96
ln t6 fort.6
ln t7 fort.7
ln t8 fort.8
ln t10 fort.10
ln t11 fort.11
ln t12 fort.12
ln t18 fort.18
ln t19 fort.19
ln t50 fort.50
ln t54 fort.54
ln t57 fort.57
ln t59 fort.59
ln t61 fort.61
ln t63 fort.63
ln t66 fort.66
ln t67 fort.67
ln t68 fort.68
ln t70 fort.70
ln t76 fort.76
ln t77 fort.77
ln t78 fort.78
ln t79 fort.79
ln t93 fort.93
ln t95 fort.95
ln t96 fort.96
cp $HOME/data.bank t70# data bank
jad
#$HOME/htcan < data
htcan < filename.filetype
jar -a
cp t18 patran.beam
rm core fort* tmp* data t*
exit
```



HITCAN Demonstration Manual - Version I.0

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13. ABSTRACT (Maximum 200 words) This manual comprises a variety of demonstration cases for the HITCAN (High Temperature Composite ANalyzer) code. HITCAN is a general purpose computer program for predicting nonlinear global structural and local stress-strain response of arbitrarily oriented, multilayered high temperature metal matrix composite structures. HITCAN is written in FORTRAN 77 computer language and has been configured and executed on the NASA Lewis Research Center CRAY XMP and YMP computers. Detailed description of all program variables and terms used in this manual may be found in the USER'S MANUAL. The demonstration manual includes various cases to illustrate the features and analysis capabilities of the HITCAN computer code. These cases include: 1) static analysis, 2) nonlinear quasi-static (incremental) analysis, 3) modal analysis, 4) buckling analysis, 5) fiber degradation effects, 6) fabrication-induced stresses for a variety of structures; namely, beam, plate, ring, shell, and built-up structures. A brief discussion of each demonstration case with the associated input data file is provided. Sample results taken from the actual computer output are also included.				
14. SUBJECT TERMS Metal matrix composite structures; Fiber composites; Composite mechanics; Laminate analysis; Micro stresses; Micromechanics; High temperature; Thermal properties; Material non-linearities; 2D and 3D nonlinear analysis; Finite elements; Buckling; Stress analysis; Vibrations			15. NUMBER OF PAGES 139	
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