Table 17 Output file, try4.OPM, from the GENOPT processor, OPTIMIZE, for the final optimum design with the outer pressure, POUTER, set equal to 15 psi and the factor of safety for buckling set equal to 1.0

==============================================================================

n $ Do you want a tutorial session and tutorial output?

0 $ Choose an analysis you DON'T want (1, 2,..), IBEHAV

2 $ NPRINT= output index (0=GOOD, 1=ok, 2=debug, 3=too much)

2 $ Choose type of analysis (1=opt., 2=fixed, 3=sensit.) ITYPE

5 $ How many design iterations in this run (3 to 25)?

n $ Take "shortcuts" for perturbed designs (Y or N)?

1 $ Choose 1 or 2 or 3 or 4 or 5 for IDESIGN

1 $ Choose 1 or 2 or 3 or 4 or 5 for move limits, IMOVE

y $ Do you want default (RATIO=10) for initial move limit jump?

y $ Do you want the default perturbation (dx/x = 0.05)?

n $ Do you want to have dx/x modified by GENOPT?

n $ Do you want to reset total iterations to zero (Type H)?

1 $ Choose IAUTOF= 1 or 2 or 3 or 4 or 5 or 6 to change X(i)

\*\*\*\*\*\*\*\*\*\*\*\* END OF THE try4.OPT FILE \*\*\*\*\*\*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\*\* AUGUST, 2010 VERSION OF GENOPT \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*\*\*\*\*\*\*\* BEGINNING OF THE try4.OPM FILE \*\*\*\*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* MAIN PROCESSOR \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

The purpose of the mainprocessor, OPTIMIZE, is to perform,

in a batch mode, the work specified by MAINSETUP for the case

called try4. Results are stored in the file try4.OPM.

Please inspect try4.OPM before doing more design iterations.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

STRUCTURAL ANALYSIS FOR DESIGN ITERATION NO. 0:

STRUCTURAL ANALYSIS WITH UNPERTURBED DECISION VARIABLES

VAR. DEC. ESCAPE LINK. LINKED LINKING LOWER CURRENT UPPER DEFINITION

NO. VAR. VAR. VAR. TO CONSTANT BOUND VALUE BOUND

1 Y N N 0 0.00E+00 4.00E+01 5.0000E+01 5.00E+01 height from inner to outer membranes: HEIGHT

2 Y N N 0 0.00E+00 6.30E+00 6.3210E+00 8.00E+00 radius of curvature of inner membrane: RINNER

3 Y N N 0 0.00E+00 9.10E+00 1.0580E+01 1.10E+01 radius of curvature of outer membrane: ROUTER

4 Y Y N 0 0.00E+00 3.00E-02 5.7210E-02 3.00E-01 thickness of the inner curved membrane: TINNER

5 Y Y N 0 0.00E+00 3.00E-02 6.2790E-02 3.00E-01 thickness of the outer curved membrane: TOUTER

6 Y Y N 0 0.00E+00 3.00E-02 1.2250E-01 3.00E-01 thickness of inner truss-core segment: TFINNR

7 Y Y N 0 0.00E+00 3.00E-02 5.7920E-02 3.00E-01 thickness of the outer truss segment: TFOUTR

8 Y Y N 0 0.00E+00 3.00E-02 4.5620E-02 3.00E-01 thickness of each truss-core web: TFWEBS

BEHAVIOR FOR 1 ENVIRONMENT (LOAD SET)

CONSTRAINT BEHAVIOR DEFINITION

NUMBER VALUE

BEHAVIOR FOR LOAD SET NUMBER, ILOADX= 1

BIGBOSOR4 input file for: general buckling load

try4.BEHX1

Changes in temperature required to create 2 total axial loads:

1. Change in temperature required to create the axial thermal

strain that generates the axial tension due to closing the

two ends of the pressurized volume (PMIDDL= 6.0000E+01)

between the inner and outer walls of the balloon in

Load Step No. 1: DELTAT= -9.9623E+01

2. Change in temperature required to simulate the Poisson

axial expansion caused by the application of the outer

pressure, POUTER = 1.5000E+01 in Load Step No. 2: DELT= 0.0000E+00

GENERAL BUCKLING LOAD FACTORS AND MODES (BEHX2)

1.0043E+00( 1)

Critical buckling load factor, GENBUK= 1.0043E+00

Critical number of axial half-waves, NWVCRT= 1

Differences in the resultants along the axis of the prismatic

balloon for each segment, J, of the first module:

[N2VAR(J) for the total load] - [N2FIX(J) for the fixed load]=

N2DIFF(J),J=1,6)= -1.9402E+02 -5.7560E+01 -5.4458E+02 -3.4890E+00

-3.2172E+01 -3.2069E+01

N2VAR(J) (total load) are the resultants from Load Step No. 2.

N2FIX(J) (fixed load) are the resultants from Load Step No. 1.

NOTE: The stresses used as behavioral constraints are

computed from N2VAR(J)/thickness(J). These stresses are

lower than those computed from N2FIX(J)/thickness(J).

PREBUCKLING STRESS RESULTANTS IN THE FIRST MODULE

"fixed" from Load Step No. 1 total from Load Step No. 2

Seg.J Node I N1FIX(I,J) N2FIX(I,J) N1VAR(I,J) N2VAR(I,J)

1 1 7.9503E+02 4.8957E+02 1.4830E+02 2.9555E+02

2 1 6.6087E+02 4.7043E+02 4.6900E+02 4.1287E+02

3 1 1.8187E+03 1.0766E+03 3.3898E+00 5.3201E+02

4 1 3.8914E+02 3.6472E+02 3.7751E+02 3.6123E+02

5 1 4.9059E+02 3.4492E+02 3.8335E+02 3.1275E+02

6 1 4.9013E+02 3.4478E+02 3.8324E+02 3.1272E+02

PREBUCKLING MEMBRANE STRESSES IN THE FIRST MODULE COMPUTED FROM

N1FIX/thickness, N2FIX/thickness, N1VAR/thickness, N2VAR/thickness:

"fixed" from Load Step No. 1 total from Load Step No. 2

Seg.J Node I STRS1F(I,J) STRS2F(I,J) STRS1V(I,J) STRS2V(I,J)

1 1 1.3726E+04 8.4525E+03 2.5605E+03 5.1027E+03

2 1 1.0525E+04 7.4921E+03 7.4694E+03 6.5754E+03

3 1 1.4846E+04 8.7885E+03 2.7672E+01 4.3429E+03

4 1 6.8019E+03 6.3752E+03 6.5986E+03 6.3142E+03

5 1 1.0754E+04 7.5607E+03 8.4031E+03 6.8555E+03

Behavior number, General buckling load factor:

Newton iterations required to solve the nonlinear

axisymmetric pre-buckling equilibrium state for the

"fixed" loads (PINNER, PMIDDL, DELTAT): ITER= 5

Newton iterations required to solve the nonlinear

axisymmetric pre-buckling equilibrium state for the

total loads (PINNER, PMIDDL, DELTAT, POUTER): ITER= 4

1 1.004345 general buckling load factor: GENBUK(1 )

BEHAVIOR OVER J = stress component number

BIGBOSOR4 input file for: stress components in materials 1,2,3

try4.BEHX2

Maximum stress components in the entire structure at the last load step (from BIGBOSOR4):

1 1.0811E+00 effect. stress: matl=1 , A , seg=26, node=32, layer=1 ,z= 0.03

2 2.2629E+00 effect. stress: matl=2 , A , seg=1 , node=33, layer=1 ,z= 0.03

3 1.2587E+00 effect. stress: matl=3 , A , seg=66, node=33, layer=1 ,z=-0.02

FIVE STRESS COMPONENTS (including bending) FOR MATL i, STRCi(ILOADX,J), J=1,5:

fiber tension fiber compres transv tension transv compres in-plane shear

or effect.stress

Material 1 stress: STRC1(ILOADX,J),J=1,5)=

9.2497E+03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Material 2 stress: STRC2(ILOADX,J),J=1,5)=

4.4191E+03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Material 3 stress: STRC3(ILOADX,J),J=1,5)=

7.9447E+03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Changes in temperature required to create 2 total axial loads:

1. Change in temperature required to create the axial thermal

strain that generates the axial tension due to closing the

two ends of the pressurized volume (PMIDDL= 6.0000E+01)

between the inner and outer walls of the balloon in

Load Step No. 1: DELTAT= -9.9623E+01

2. Change in temperature required to simulate the Poisson

axial expansion caused by the application of the outer

pressure, POUTER = 1.5000E+01 in Load Step No. 2: DELT= 2.9784E+01

BEHAVIOR OVER J = stress component number

2 7469.398 stress component in material 1: STRM1(1 ,1 )

3 0.1000000E-09 stress component in material 1: STRM1(1 ,2 )

4 6575.421 stress component in material 1: STRM1(1 ,3 )

5 0.1000000E-09 stress component in material 1: STRM1(1 ,4 )

6 0.1000000E-09 stress component in material 1: STRM1(1 ,5 )

BEHAVIOR OVER J = stress component number

7 2560.475 stress component in material 2: STRM2(1 ,1 )

8 0.1000000E-09 stress component in material 2: STRM2(1 ,2 )

9 5102.743 stress component in material 2: STRM2(1 ,3 )

10 0.1000000E-09 stress component in material 2: STRM2(1 ,4 )

11 0.1000000E-09 stress component in material 2: STRM2(1 ,5 )

BEHAVIOR OVER J = stress component number

12 8403.080 stress component in material 3: STRM3(1 ,1 )

13 0.1000000E-09 stress component in material 3: STRM3(1 ,2 )

14 6855.525 stress component in material 3: STRM3(1 ,3 )

15 0.1000000E-09 stress component in material 3: STRM3(1 ,4 )

16 0.1000000E-09 stress component in material 3: STRM3(1 ,5 )

\*\*\*\*\* RESULTS FOR LOAD SET NO. 1 \*\*\*\*\*\*

PARAMETERS WHICH DESCRIBE BEHAVIOR (e.g. stress, buckling load)

BEH. CURRENT

NO. VALUE DEFINITION

1 1.004E+00 general buckling load factor: GENBUK(1 )

2 7.469E+03 stress component in material 1: STRM1(1 ,1 )

3 1.000E-10 stress component in material 1: STRM1(1 ,2 )

4 6.575E+03 stress component in material 1: STRM1(1 ,3 )

5 1.000E-10 stress component in material 1: STRM1(1 ,4 )

6 1.000E-10 stress component in material 1: STRM1(1 ,5 )

7 2.560E+03 stress component in material 2: STRM2(1 ,1 )

8 1.000E-10 stress component in material 2: STRM2(1 ,2 )

9 5.103E+03 stress component in material 2: STRM2(1 ,3 )

10 1.000E-10 stress component in material 2: STRM2(1 ,4 )

11 1.000E-10 stress component in material 2: STRM2(1 ,5 )

12 8.403E+03 stress component in material 3: STRM3(1 ,1 )

13 1.000E-10 stress component in material 3: STRM3(1 ,2 )

14 6.856E+03 stress component in material 3: STRM3(1 ,3 )

15 1.000E-10 stress component in material 3: STRM3(1 ,4 )

16 1.000E-10 stress component in material 3: STRM3(1 ,5 )

\*\*\*\*\*\*\* NOTE \*\*\*\*\*\*\* NOTE \*\*\*\*\*\*\* NOTE \*\*\*\*\*\* NOTE \*\*\*\*\*\*

The phrase, "NOT APPLY", for MARGIN VALUE means that that

particular margin value is exactly zero.

\*\*\* END NOTE \*\*\* END NOTE \*\*\* END NOTE \*\*\* END NOTE \*\*\*\*\*

\*\*\*\*\* RESULTS FOR LOAD SET NO. 1 \*\*\*\*\*\*

MARGINS CORRESPONDING TO CURRENT DESIGN (F.S.= FACTOR OF SAFETY)

MARGIN CURRENT

NO. VALUE DEFINITION

1 4.345E-03 (GENBUK(1 )/GENBUKA(1 )) / GENBUKF(1 )-1; F.S.= 1.00

2 3.388E-01 (STRM1A(1 ,1 )/STRM1(1 ,1 )) / STRM1F(1 ,1 )-1; F.S.= 1.00

3 5.208E-01 (STRM1A(1 ,3 )/STRM1(1 ,3 )) / STRM1F(1 ,3 )-1; F.S.= 1.00

4 2.906E+00 (STRM2A(1 ,1 )/STRM2(1 ,1 )) / STRM2F(1 ,1 )-1; F.S.= 1.00

5 9.597E-01 (STRM2A(1 ,3 )/STRM2(1 ,3 )) / STRM2F(1 ,3 )-1; F.S.= 1.00

6 1.900E-01 (STRM3A(1 ,1 )/STRM3(1 ,1 )) / STRM3F(1 ,1 )-1; F.S.= 1.00

7 4.587E-01 (STRM3A(1 ,3 )/STRM3(1 ,3 )) / STRM3F(1 ,3 )-1; F.S.= 1.00

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* DESIGN OBJECTIVE \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\* \*\*\*\*\*\*\*\*\*\*\*

CURRENT VALUE OF THE OBJECTIVE FUNCTION:

VAR. CURRENT

NO. VALUE DEFINITION

1 5.738E+01 weight/length of the balloon: WEIGHT

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* DESIGN OBJECTIVE \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\* ALL 1 LOAD CASES PROCESSED \*\*\*\*\*\*\*\*\*\*\*

======================================================================