Table 18 Output data from the PANDA2 processor PANDAOPT with NPRINT = 0 and ITYPE = 2. Flat panel with the same design as the optimized design of the curved panel (allenflat.OPM). There are 5 stringer bays and one ring bay.

```
==========================================================================
      n          $ Do you want a tutorial session and tutorial output?
   -1000.00      $ Resultant (e.g. lb/in) normal to the plane of screen, Nx( 1)
   0.000000      $ Resultant (e.g. lb/in) in the plane of the screen,    Ny( 1)
   0.000000      $ In-plane shear in load set A,                  Nxy( 1)
      N          $ Does the axial load vary in the L2 direction?
   0.000000      $ Applied axial moment resultant (e.g. in-lb/in), Mx( 1)
   0.000000      $ Applied hoop moment resultant (e.g. in-lb/in), My( 1)
      Y          $ Want to include effect of transverse shear deformation?
         0       $ IQUICK = quick analysis indicator (0 or 1)
      Y          $ Do you want to vary M for minimum local buckling load?
      N          $ Do you want to choose a starting M for local buckling?
      Y          $ Do you want to perform a "low-axial-wavenumber" search?
   0.999000      $ Factor of safety for general instability, FSGEN( 1)
   0.999000      $ Factor of safety for panel (between rings) instability, FSPAN( 1)
  0.1000000      $ Minimum load factor for local buckling (Type H for HELP), FSLOC( 1)
   1.000000      $ Minimum load factor for stiffener buckling (Type H), FSBSTR( 1)
   1.000000      $ Factor of safety for stress, FSSTR( 1)
      n          $ Do you want "flat skin" discretized module for local buckling?
      n          $ Do you want to skip the KOITER local postbuckling analysis?
      n          $ Do you want wide-column buckling to constrain the design?
         0       $ Resultant (e.g. lb/in) normal to the plane of screen, Nx0( 1)
         0       $ Resultant (e.g. lb/in) in the plane of the screen,    Ny0( 1)
         0       $ Axial load applied along the (0=neutral plane), (1=panel skin)
   0.000000      $ Uniform applied pressure [positive upward. See H(elp)], p( 1)
   0.000000      $ Out-of-roundness, Wimpg1=(Max.diameter-Min.diam)/4, Wimpg1( 1)
   0.000000      $ Initial buckling modal general imperfection amplitude, Wimpg2( 1)
   0.000000      $ Initial buckling modal inter-ring imperfection amplitude,Wpan( 1)
  0.1000000E-06  $ Initial local imperfection amplitude (must be positive), Wloc( 1)
      Y          $ Do you want PANDA2 to change imperfection amplitudes (see H(elp))?( 1)
    9.7793       $ Axial halfwavelength of typical general buckling mode, AXLWAV( 1)
      Y          $ Do you want PANDA2 to find the general imperfection shape?( 1)
   1.000000      $ Maximum allowable average axial strain (type H for HELP)( 1)
      N          $ Is there any thermal "loading" in this load set (Y/N)?
      Y          $ Do you want a "complete" analysis (type H for "Help")?
      N          $ Want to provide another load set ?
      N          $ Do you want to impose minimum TOTAL thickness of any segment?
      N          $ Do you want to impose maximum TOTAL thickness of any segment?
      N          $ Do you want to impose minimum TOTAL thickness of any segment?
      N          $ Do you want to impose maximum TOTAL thickness of any segment?
      N          $ Use reduced effective stiffness in panel skin (H(elp), Y or N)?
         0       $ NPRINT= output index (-1=min. 0=good, 1=ok, 2=more, 3=too much)
         1       $ Index for type of shell theory (0 or 1 or 2), ISAND
      Y          $ Does the postbuckling axial wavelength of local buckles change?
      Y          $ Want to suppress general buckling mode with many axial waves?
      N          $ Do you want to double-check PANDA-type eigenvalues [type (H)elp]?
         1       $ Choose (0=transverse inextensional; 1=transverse extensional)
         1       $ Choose ICONSV = -1 or 0 or 1 or H(elp), ICONSV
         2       $ Choose type of analysis (ITYPE = 1 or 2 or 3 or 4 or 5)
      Y          $ Do you want to prevent secondary buckling (mode jumping)?
      N          $ Do you want to use the "alternative" buckling solution?
         5       $ How many design iterations permitted in this run (5 to 25)?
   1.000000      $ MAXMAR. Plot only those margins less than MAXMAR (Type H)
      N          $ Do you want to reset total iterations to zero (Type H)?
```

```
       1      $ Index for objective (1=min. weight, 2=min. distortion)
  1.000000     $ FMARG (Skip load case with min. margin greater than FMARG)

************ END OF THE  allenflat.OPT  FILE ***********
************ NOVEMBER, 2009 VERSION OF PANDA2   ************
******** BEGINNING OF THE  allenflat.OPM  FILE *********



****************************************
ITERATION NO., LOAD SET NO., SUBCASE NO. =   0   1   1     PANEL MIDLENGTH
****************************************
****************************************
ENTERING STRUCT. IMOD= 0
ITERATION NO., LOAD SET NO., SUBCASE NO. =   0   1   1       CURRENT DESIGN
****************************************
```

The numbers of the references [ ] given in the CHAPTER
headings correspond to those listed at the end of the paper:
Bushnell, D.
"Optimization of an axially compressed ring and stringer
stiffened cylindrical shell with a general buckling modal
imperfection", AIAA Paper 2007-2216, 48th AIAA SDM Meeting,
Honolulu, Hawaii, April 2007

The overall structure of PANDA2 and its use are described in
the first PANDA2 paper, Ref.[1A], cited in the April 2007
paper just identified. Ref.[1A] is the following paper:
Bushnell, D.,
"PANDA2 - Program for minimum weight design of stiffened,
composite, locally buckled panels", COMPUTERS AND STRUCTURES,
Vol. 25, No. 4, pp 469-605, 1987

Concepts such as "wide-column" buckling, "discretized module
model", "stringer pop-off", "constitutive matrices"
"reduction factor for transverse shear deformtion (t.s.d.)"
"smeared stiffeners", "neutral surface", "overall and local
static response to uniform pressure", "knockdown factors for
anisotropy and in-plane shear loading", "crippling of
stiffener parts", and "local postbuckling" are described
there, with many early PANDA2 examples provided.

The string, "PANDA-type theory" often occurs. This refers to
the theory presented in Ref. [1B] of the April 2007 citation
listed first. Ref.[1B] contains the theory given in the paper:
Bushnell, D.,
"Theoretical basis of the PANDA computer program for
preliminary design of stiffened panels under combined in-
plane loads", COMPUTERS & STRUCTURES, v. 27, No. 4,
pp 541-563 (1987).

The theory used for local postbuckling behavior appears in
Ref. [1C] of the April 2007 paper cited first (above).
Ref. [1C] is the following paper:
Bushnell, D.,
"Optimization of composite, stiffened, imperfect panels
under combined loads for service in the postbuckling
regime", Computer Methods in Applied Mechanics and

```
Engineering, Vol. 103 (1993) 43-114

The theory used for imperfection sensitivity appears in
Refs. [1E] and [1D] of the first-cited paper above.
Refs. [1E] and [1D] are the following two papers:

Bushnell, D. and Bushnell, W. D.,
"Approximate method for the optimum design of ring and
stringer stiffened cylindrical panels and shells with
local, inter-ring, and general buckling modal imperfections"
Computers and Structures, Vol. 59, No. 3, pp 489-527 (1996)

Bushnell, D.,
"Recent enhancements to PANDA2" AIAA Paper 96-1337-CP,
Proc. of the AIAA 37th Structures, Structural Dynamics and
Materials Conference, pp 126-182, April, 1996.

The last paper cited also describes the "global" optimizer,
"SUPEROPT", implementation of Sanders shell equations into
PANDA2, implementation of the Arbocz theory for imperfection
sensitivity, implementation of isogrid geometry, and
implementation of various truss-core geometries, with examples.

The theories used in PANDA2 for the analysis of sandwich
walls are given in Ref.[1F] of the first-cited paper above.
Ref. [1K] is the following paper:
Bushnell, D.,
"Optimum design via PANDA2 of composite sandwich panels with
honeycomb or foam cores", AIAA Paper 97-1142, Proc. 38th AIAA
Structures, Structural Dynamics and Materials Conference,
pp 2163-2202, April, 1997

The "alternate" (double-trigonometric series expansion
buckling theory) and the discretized "skin"-ring module
model are described in Ref. [1G] of the first-cited paper.
Ref. [1G] is the following paper:
Bushnell, D., Jiang, H., and Knight, N.F.,
"Additional buckling solutions in PANDA2", Proceedings of the
40th AIAA SDM Conference, AIAA Paper 99-1233, pp 302-345
April 1999

Details of the strategy used in PANDA2 for accounting for
initial buckling modal imperfections are described and listed
in a table in Ref. [1K]. Ref. [1K] is the following paper:
Bushnell, D. and Rankin, C.C.,
"Difficulties in optimization of imperfect stiffened
cylindrical shells",
AIAA Paper 1943, 47th AIAA Structures, Structural Dynamics and
Materials Meeting, Newport RI, April 2006
**** CHAPTER  1: DESIGN PERTURBATION INDEX, IMOD=  0 *****
**** END   SUBROUTINE GETCIJ (CONSTIT. LAW: SEGS AND SMEARED ***
**** CHAPTER  3: DESIGN PERTURBATION INDEX, IMOD=  0 *****

User-specified axial length of the panel, AXIAL=  9.7793E+00
Computed factor to modify the length, AXIAL: LENMOD=  1.0000E+00
Axial length of "equivalent" simply-supported panel, LENMOD*AXIAL=  9.7793E+00
**** CHAPTER  6: DESIGN PERTURBATION INDEX, IMOD=  0 *****
```

```
 GENERAL BUCKLING LOAD FACTOR USED FOR CALCULATION OF THE
 AMPLIFICATION OF BOWING FROM ALL SOURCES EXCEPT PRESSURE.
 EIGBOW(M,N)=  4.1826E+06(  1,  1)
 **** END SUBROUTINE BUCPAN (PRELIM. PANDA-TYPE BUCKLING) *******
 **** CHAPTER  7: DESIGN PERTURBATION INDEX, IMOD=  0 *****

*** BEGIN SUB. BUCPAN (LOAD B PANDA-TYPE BUCKLING LOADS) ****
 Margin=  1.7676E+06  buck.(SAND);simp-support local buck.; M=4;N=1;slope=0.01;FS=0.1
 Margin=  3.4744E+06  buck.(SAND);simp-support smear string;M=1;N=1;slope=0.;FS=0.999
 Margin=  4.1868E+06  buck.(SAND);simp-support general buck;M=1;N=1;slope=0.;FS=0.999
 Margin=  8.1459E+06  buck.(SAND);rolling with local buck.; M=2;N=1;slope=0.03;FS=0.1
 Margin=  3.4756E+06  buck.(SAND);rolling with smear string;M=1;N=1;slope=0.;FS=0.999
 Margin=  3.9169E+06  buck.(SAND);rolling only of stringers;M=7;N=0;slope=0.;FS=1.4
 ***** END SUB. BUCPAN (LOAD B PANDA-TYPE BUCKLING LOADS) ****

***** BEGIN SUB. STFEIG (LOAD B BUCKLING IN STIFFENERS) *****
 Margin=  2.2706E+06  buckling margin stringer Iseg.3 . Local halfwaves=4  .MID.;FS=1.
 ******* END SUB. STFEIG (LOAD B BUCKLING IN STIFFENERS) *****
  *** END OF LOAD B STIFFENER SEGMENT BUCKLING (if any) ****

  ****** RESULTS FOR LOAD SET B BUCKLING ******
  NOTE: FOLLOWING MARGINS COMPUTED WITH THE
        FACTORS OF SAFETY SET TO UNITY.
0
  MARGINS FOR DESIGN SUBJECTED ONLY TO THE LOADS IN LOAD SET B:
 MAR. MARGIN
 NO.  VALUE                DEFINITION
 1  1.77E+05 buck(SAND)simp-support local buck.;  MIDLENGTH
 2  3.47E+06 buck(SAND)simp-support smear string; MIDLENGTH
 3  4.18E+06 buck(SAND)simp-support general buck; MIDLENGTH
 4  8.15E+05 buck(SAND)rolling with local buck.;  MIDLENGTH
 5  3.47E+06 buck(SAND)rolling with smear string; MIDLENGTH
 6  5.48E+06 buck(SAND)rolling only of stringers; MIDLENGTH
 7  2.27E+06 buckling: stringer seg.3 . MIDLENGTH
 **** CHAPTER  1: DESIGN PERTURBATION INDEX, IMOD=  0 *****
 **** END   SUBROUTINE GETCIJ (CONSTIT. LAW: SEGS AND SMEARED ***
 **** CHAPTER  3: DESIGN PERTURBATION INDEX, IMOD=  0 *****

 User-specified axial length of the panel, AXIAL=  9.7793E+00
 Computed factor to modify the length, AXIAL: LENMOD=  1.0000E+00
 Axial length of "equivalent" simply-supported panel, LENMOD*AXIAL=  9.7793E+00
 ** CHAPTER  NEW1: DESIGN PERTURBATION INDEX, IMOD=  0 ***

 ******* Begin the section where WIDKNK is computed *********
 ******* See ..panda2/doc/panda2.news Items 724 & 725.*******
 *** CHAPTER  NEW3: DESIGN PERTURBATION INDEX, IMOD=  0 ***

  WIDE COLUMN PANEL BUCKLING LOAD FACTOR =   2.4597E+00
 ISKINX = 0. MODE OF BUCKLING IS THE PANEL SKIN IF ISKINX = 1.
 ITIPWX = 0. MODE OF BUCKLING IS STRINGER SIDESWAY IF ITIPWX=1
 ICWBWX = 0. MODE OF BUCKLING IS THE STRINGER WEB IF ICWBWX=1
 IFLGWX = 0. MODE OF BUCKLING IS STRINGER OUTSTANDING FLANGE IF IFLGWX=1
 ICRWNX = 0. MODE OF BUCKLING IS THE CROWN OF THE HAT IF ICRWNX=1

 Mode number  1 IS a wide column mode and is therefore acceptable.

 SMEARED STRINGER KNOCKDOWN FROM SKIN-STRINGER DISCRETE MODEL
 (See ..panda2/doc/panda2.news Items 724 and 725):
```

```
 Buckling axial resultant Nx from simple Euler model,   EULER =  5.1119E+03
 Buckling axial resultant Nx from discretized  model,   EIGWID=  2.4597E+03
 Knockdown factor for cross section rigidity & t.s.d.,  WIDKNK=  4.8117E-01
 Effective axial length of the wide column model,       AXLEFF=  9.7793E+00

 Axial resultant, Nx, in each of the segments of the
 discretized skin-stringer cross-section before any deformation
 -4.6893E+02 -4.6893E+02 -1.5488E+03 -4.6893E+02
 ******* End of the section where WIDKNK is computed ********
 ******* See ..panda2/doc/panda2.news Items 724 & 725.*******

 **** CHAPTER  6: DESIGN PERTURBATION INDEX, IMOD=  0 *****

 GENERAL BUCKLING LOAD FACTOR USED FOR CALCULATION OF THE
 AMPLIFICATION OF BOWING FROM ALL SOURCES EXCEPT PRESSURE.
 EIGBOW(M,N)=  4.1826E+00(  1,  1)
 **** END SUBROUTINE BUCPAN (PRELIM. PANDA-TYPE BUCKLING) *******
 **** CHAPTER  7: DESIGN PERTURBATION INDEX, IMOD=  0 *****
 **** CHAPTER  8: DESIGN PERTURBATION INDEX, IMOD=  0 *****

 Entering ALTSOL: radius, axial, circ. dimensions =  1.5755E+05  9.7793E+00  2.4705E+00
 See ITEMs 438, 444  in the file ..panda2/doc/panda2.news .
 and AIAA paper 99-1233, Proc. 40th AIAA SDM Meeting, 1999
 pp 302-345, especially pp 304-316 and associated figures.
 *** BUCKLING BETW MAJOR STIFFENERS, SMEARED SUBSTIFFENERS ***
         Number of discrete stringers, rings: NUMSTR, NUMRNG=  0  0

 No alternative solution sought because user did not want one.
 (IALTSN was set equal to zero in MAINSETUP)

 Label No. in STRUCT= 9140: Modifiers for knockdowns
 generated from use of the alternative buckling soln.(if any)
  General Instability, FKNOCK(1), EIGRT9 =  1.0000E+00  1.0000E+00
  Local Buckling,      FKNOCK(2), EIGRT7 =  9.9999E-01  1.0000E+00
**** END SUBROUTINE BUCPAN (KNOCKDOWN PANDA-TYPE BUCKL.) ******
**** Knockdown factors to account for anisotropy and/or the
**** presence of in-plane shear, in order to compensate for the
**** neglect of these in the BOSOR4-type discretized models for
**** buckling.
****************************************************************


 Conservativeness indicator, ICONSV= 1 (See panda2.news Item No. 676)
 Initial imperfections for general, panel, local buckling=
 Total out-of-roundness + modal,    W0GLOB =  0.0000E+00
 Out-of-roundness,                    WG1  =  0.0000E+00
 General buckling modal,              WG2  =  0.0000E+00
 Inter-ring buckling modal,         W0PAN =  0.0000E+00
 Local buckling modal,              W0LOC =  1.0000E-07
 **** CHAPTER 10: DESIGN PERTURBATION INDEX, IMOD=  0 ****

 *************************************************************
 CHAPTER 10 Compute knockdown factors and prebuckling bending
            associated with initial general, inter-ring, local
            buckling modal imperfections. (See Ref.[1E].
            Also see Sections 13 and 14 and Tables 9 and 10
            of Ref.[1K]).
 **** CHAPTER 10.1: DESIGN PERTURBATION INDEX, IMOD=  0 ***
```

```
**************************************************************
CHAPTER 10.1 Compute knockdown factor and prebuckling bending
             associated with GENERAL buckling modal initial
             imperfection. (See Sectons 13 and 14 and
             Tables 9 and 10 of [1K] for a detailed example)
GENERAL BUCKLING EIGENV. OF PERFECT PANEL, IMOD= 0
  EILC91(m,dm,n,dn,s)=  4.1826E+00(  1, 0.000E+00,  1, 0.000E+00, 0.000E+00)


************ ITERATION LOOP FOR IMPERFECT PANEL ***********
Begin iteration loop for general buckling of the imperfect
panel. The general imperfection is amplified by the factor
WYYAMP, which increases from iteration to iteration.

*************** ITERATION NUMBER  1 *****************
GENERAL BUCKLING EIGENV. OF IMPERFECT PANEL, IMOD= 0
  EILOC9(m,dm,n,dn,s)=  4.1826E+00(  1, 0.000E+00,  1, 0.000E+00, 0.000E+00)
IMPERFECTION AMPLITUDE FACTOR, WYYAMP=  1.3142E+00
EIGEFF =RNGKNZ*(FACIM1*EILOC9 +FACIM2*FMULT2*EILC91)/(FACIM1+FMULT2*FACIM2)=  4.1826E+00
in which FACIM1, FACIM2, and EILC91 are given by:
FACIM1=1./(EILOC9 - 1.) =  3.1420E-01
FACIM2=1./(EILC91 - 1.) =  3.1420E-01
EILC91                  =  4.1826E+00
FMULT2                  =  1.0000E+00
RNGKNZ                  =  1.0000E+00

*************** ITERATION NUMBER  2 *****************

*** NOTE: The number of circ. halfwaves in the general
          buckling mode of the PERFECT panel is less than or
          equal to that for the IMPERFECT panel. Therefore,
          the IMPERFECT panel mode is used for computation
          of deformations Wxx, Wyy, Wxy in SUBROUTINE CURIMP.
ICD91, ICD9  = indicators for coordinate direction
               in which panel is longest.
General buckling mode for the PERFECT panel (PANDA theory):
(m=  1, dm=  0.00E+00, n=  1, dn=  0.00E+00, slope=  0.00E+00, ICD91= 1)
General buckling mode for the IMPERFECT panel (PANDA theory):
(m=  1, dm=  0.00E+00, n=  1, dn=  0.00E+00, slope=  0.00E+00 ICD9= 1)
(0.1 radian)/(shell wall rotation), AMPTST =  1.0000E+00
 Original imperfection is increased by 1/(EIGEFF-1)=  3.1420E-01
**** CHAPTER 10.2: DESIGN PERTURBATION INDEX, IMOD=  0 ***

**************************************************************
CHAPTER 10.2 Compute knockdown factor and prebuckling bending
             associated with INTER-RING buckling modal
             initial imperfection.
INTER-RING BUCKLING EIGENV. OF "PERFECT" PANEL, IMOD= 0
  EILC81(m,dm,n,dn,s)=  2.0732E+00(  1, 0.000E+00,  1, 0.000E+00, 0.000E+00)


************ ITERATION LOOP FOR IMPERFECT PANEL ***********
Begin iteration loop for inter-ring buckling of the imperfect
panel. The inter-ring imperfection is amplified by the factor
WYYAMP, which increases from iteration to iteration.

*************** ITERATION NUMBER  1 *****************
```

```
INTER-RING BUCKLING EIGENV. OF IMPERFECT PANEL, IMOD= 0
  EILOC8(m,dm,n,dn,s)=  2.0732E+00(  1, 0.000E+00,  1, 0.000E+00, 0.000E+00)
INTER-RING IMPERFECTION AMPLITUDE FACTOR, WYYAMP=  1.9318E+00
EIGEFF =FACIM1*EILOC8 +FACIM2*FMULT2*EILC81)/(FACIM1+FMULT2*FACIM2)=  2.0732E+00
in which FACIM1, FACIM2, and EILC81 are given by:
FACIM1=1./(EILOC8 - 1.) =  9.3181E-01
FACIM2=1./(EILC81 - 1.) =  9.3181E-01
EILC81                  =  2.0732E+00
FMULT2                  =  1.0000E+00

*************** ITERATION NUMBER  2 *****************

*** NOTE: The number of circ. halfwaves in the inter-ring
          buckling mode of the PERFECT panel is less than or
          equal to that for the IMPERFECT panel. Therefore,
          the IMPERFECT panel mode is used for computation
          of deformations Wxx, Wyy, Wxy in SUBROUTINE CURIMP.
ICD81, ICD8  = indicators for coordinate direction
               in which the inter-ring portion of the
               panel is longest.
Inter-ring buckling mode for the PERFECT panel (PANDA theory):
(m=  1, dm=  0.00E+00, n=  1, dn=  0.00E+00, slope=  0.00E+00, ICD81= 1)
Inter-ring buckling mode for IMPERFECT panel (PANDA theory):
(m=  1, dm=  0.00E+00, n=  1, dn=  0.00E+00, slope=  0.00E+00 ICD8= 1)

(0.1 radian)/(shell wall rotation), AMPTST =  3.1128E+09
QUANTITIES USED FOR INTER-RING BENDING OF IMPERFECT PANEL
(used for generation of WXX8,WYY8,WXY8), IMOD= 0:
 Amplitude of overall ovalization,              WG1=  0.0000E+00
 Amplitude of inter-ring buckling modal imp.,AMWIMP= -1.0000E-10
 Effective load factor for inter-ring buck., EIGEFF=  2.0732E+00
 Number of  axial halfwaves in inter-ring mode,   m=    1
 Fractional axial halfwaves in inter-ring mode,  dm=  0.0000E+00
 Number of  circ. halfwaves in inter-ring mode,   n=    1
 Fractional circ. halfwaves in inter-ring mode,  dn=  0.0000E+00
 Slope of nodal lines in inter-ring buck.mode,slope=  0.0000E+00
 Additional amplitude factor,                FACIM3=  1.0000E+00
 Original imperfection is increased by 1/(EIGEFF-1)=  9.3181E-01

********* NOTE ********* NOTE ********** NOTE *********
Prebuckling bending and twist from inter-ring imperfection growth:
   Wxx8,Wyy8,Wxy8,ICD8= -9.6163E-12 -6.0272E-12 -7.6131E-12    1
******************************************************
**** CHAPTER 10.3: DESIGN PERTURBATION INDEX, IMOD=  0 ***

*************************************************************
CHAPTER 10.3 Compute knockdown factor and prebuckling bending
             associated with LOCAL buckling modal initial
             imperfection.
LOCAL BUCKLING EIGENV. OF "PERFECT" PANEL, IMOD= 0
  EILC71(m,dm,n,dn,s)=  1.7676E-01(  4, 0.000E+00,  1, 0.000E+00, 1.000E-02)


************ ITERATION LOOP FOR IMPERFECT PANEL ***********
Begin iteration loop for local buckling of the imperfect
panel. The local imperfection is amplified by the factor
WYYAMP, which increases from iteration to iteration.
```

```
*************** ITERATION NUMBER  1 *****************
(0.1 radian)/(shell wall rotation), AMPTST =  7.7821E+05
The radius of curvature is modified by initial imperfections:
Orig.radius  Mod.radius  WYYGEN    WYYOUT    WYYPAN    CURCHG
 1.575E+05  1.754E+05  0.000E+00  0.000E+00  1.250E-11  6.468E-07
LOCAL BUCKLING EIGENV. OF IMPERFECT PANEL, IMOD= 0
  EILOC7(m,dm,n,dn,s)=  1.7676E-01(  4, 0.000E+00,  1, 0.000E+00, 1.000E-02)
LOCAL IMPERFECTION AMPLITUDE FACTOR, WYYAMP=  4.0000E+00
EIGEFF =(FACIM1*EILOC7 +FACIM2*FMULT2*EILC71)/(FACIM1+FMULT2*FACIM2)=  1.7676E-01
in which FACIM1, FACIM2, and EILC71 are given by:
FACIM1=1./(EILOC7 - 1.) =  1.0000E+02
FACIM2=1./(EILC71 - 1.) =  1.0000E+02
EILC71                  =  1.7676E-01
FMULT2                  =  1.0000E+00

*** NOTE: The number of circ. halfwaves in the local
          buckling mode of the PERFECT panel is less than or
          equal to that for the IMPERFECT panel. Therefore,
          the IMPERFECT panel mode is used for computation
          of deformations Wxx, Wyy, Wxy in SUBROUTINE CURIMP.
ICD71, ICD7  = indicators for coordinate direction
               in which the "local" portion of the
               panel is longest.
Local buckling mode for the PERFECT panel (PANDA theory):
(m=  4, dm=  0.00E+00, n=  1, dn=  0.00E+00, slope=  1.00E-02, ICD71= 1)
Inter-ring buckling mode for IMPERFECT panel (PANDA theory):
(m=  4, dm=  0.00E+00, n=  1, dn=  0.00E+00, slope=  1.00E-02 ICD7= 1)
(0.1 radian)/(shell wall rotation), AMPTST =  7.7821E+05
QUANTITIES USED FOR LOCAL BENDING OF IMPERFECT PANEL
(used for generation of WXX7,WYY7,WXY7), IMOD= 0:
 Amplitude of overall ovalization,              WG1=  0.0000E+00
 Amplitude of  local  buckling modal imperf.,AMWIMP=  1.0000E-07
 Effective load factor for  local  buckling, EIGEFF=  1.7676E-01
 Number of  axial halfwaves in  local  mode,      m=    4
 Fractional axial halfwaves in  local  mode,     dm=  0.0000E+00
 Number of  circ. halfwaves in  local  mode,      n=    1
 Fractional circ. halfwaves in  local  mode,     dn=  0.0000E+00
 Slope of nodal lines in local buckling mode, slope=  1.0000E-02
 Additional amplitude factor,                FACIM3=  5.6573E+00
 Original imperfection is increased by 1/(EIGEFF-1)=  1.2147E+00

********* NOTE ********* NOTE ********** NOTE *********
Prebuckling bending and twist from local imperfection growth:
 Wxx7(1),Wyy7(1),Wxy7(1),ICD7=  2.8025E-06  2.7448E-06  2.8025E-08    1
*****************************************************
**** CHAPTER 11: DESIGN PERTURBATION INDEX, IMOD=  0 ****
**** CHAPTER 11: DESIGN PERTURBATION INDEX, IMOD=  0 ****

************************************************************
CHAPTER 11 Get change in stress resultants, Nx, Ny, Nxy in
           various segments of the skin-stringer module
           during prebuckling bending of the imperfect shell.
           Also, do PANDA-type [1B] local, inter-ring, gen-
           eral buckling analyses and PANDA-type stringer web
           and ring web buckling analyses to get knockdown
           factors to compensate for the lack of in-plane
           shear Nxy loading and anisotropy in discretized
           BOSOR4-type models. (See Section 11 in [1A])
```

```
 In-plane shear and anisotropy are not directly accounted for
 in any of the BOSOR4-type of discretized models. In order to
 compensate for this error, knockdown factors are established
 as given below for various types of buckling. These knockdowns
 account for:
  1. the effect of in-plane shear, and
  2. anisotropy [e.g. C(4,6), C(5,6)] in the panel skin.
 Knockdown factors from PANDA-type analysis are as follows:
    Knockdown factor for general instability=   1.0000E+00
    Knockdown factor for local instability=     9.9999E-01
    Knockdown factor (under hat crippling)=     1.0000E+00
    Knockdown factor for inter-ring buckling=   1.0000E+00
    Knockdown factor for stringer web bucklng=  1.0000E+00
    Knockdown factor for   ring   web bucklng=  1.0000E+00
 Please note that the purpose of these knockdown factors is NOT
 to compensate for initial imperfections.  You can account for
 initial imperfections by assigning amplitudes of local, inter-
 ring, and general imperfections in the forms of the local,
 inter-ring and general buckling modes. And/or you can use
 appropriate factors of safety (different for different
 buckling modes) to compensate for initial imperfections.

 **** CHAPTER 12: DESIGN PERTURBATION INDEX, IMOD=  0 *****
 **** CHAPTER 13: DESIGN PERTURBATION INDEX, IMOD=  0 *****
 **** CHAPTER 14: DESIGN PERTURBATION INDEX, IMOD=  0 *****

**** BEGIN SUBROUTINE LOCAL (INITIAL LOCAL BUCKLING SEARCH) ****

 Value of dm used in SUBROUTINE ARRAYS= -5.7697E-02
 IMOD= 0; Eigenvalue passed to STRUCT=  3.1983E-01
 Knockdown for transverse shear deformation=  9.9808E-01
 Buckling load factor from SUB. LOCAL, EIGITR(1)=  3.1983E-01
 Number of axial halfwaves between rings, N=    6
 ****  END  SUBROUTINE LOCAL (INITIAL LOCAL BUCKLING SEARCH) ****
  **** END OF LOCAL BUCKLING EIGENVALUE CALC.****

**** BEGIN SUBROUTINE MODE (LOCAL BUCKLING MODE SHAPE) ****
 **** END SUBROUTINE MODE (LOCAL BUCKLING MODE SHAPE) ******
 Margin=  2.1988E+00  Local buckling from discrete model-1.,M=6   axial halfwaves;FS=0.1
 **** CHAPTER 15: DESIGN PERTURBATION INDEX, IMOD=  0 *****
 Buckling load factor from SUB. LOCAL, EIGITR(4)=  3.1988E-01
 Number of axial halfwaves between rings, NLOW=    6
 **** END SUBROUTINE LOCAL (LOW-M LOCAL BUCKLING SEARCH) ******
 **** CHAPTER 16: DESIGN PERTURBATION INDEX, IMOD=  0 *****
  BEFORE POSSIBLE CHANGE: INITIAL LOCAL IMPERFECTION W0=  1.00000001E-07
  AFTER POSSIBLE CHANGE: INITIAL LOCAL IMPERFECTION W0=  1.00000001E-07

***** BEGIN SUBROUTINE KOIT2 (KOITER THEORY POSTBUCKLING) ****

 ******** ENTERING KOITER BRANCH, SUBROUTINE KOIT2 *********
 This subroutine is an implementation of the theory described
 in the PANDA2 paper by David Bushnell:
     "Optimization of composite, stiffened, imperfect panels
      under combined loads for service in the postbuckling
      regime", Computer Methods in Applied Mechanics and
      Engineering, Vol. 103 (1993) 43-114 (volume in honor of
      Besselings 65th birthday).
```

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LOCAL BIFURCATION BUCKLING LOAD FACTOR ESTIMATES
AND AMPLITUDE Wo OF LOCAL IMPERFECTION, Wo*(buckling mode)
Critical number of axial half-waves                 =  6
Slope of buckling nodal lines from Koiter Theory, m=  6.29E-03
Knockdown factor for C44, C45, C55 for transv.shear=  9.98E-01
Local buckling load Factor from Koiter-type Theory =  3.14E-01
Load Factor from BOSOR4-type panel module model    =  3.20E-01
BOSOR4-type load factor without knockdowns for
  effects of anisotropy [e.g. C(4,6)] of the skin,
  transverse shear def., or in-plane shear loading =  3.20E-01
Amplitude Wo of local imperfection                 =  1.0000E-07

Even if the load factor from Koiter-type theory is greater
than unity, the panel is in a "post-locally-buckled" state
because there is always a finite local imperfection in the
panel skin and stringer that grows under the applied loads.

Margin=  2.1393E+00  Local buckling from Koiter theory,M=6   axial halfwaves;FS=0.1

LOCAL DEFORMATION CHARACTERISTICS:
Average axial strain(not including thermal),EXAVE = -2.5757E-03
Initial local imperfection amplitude,           Wo=  1.0000E-07
Slope of local buckling nodal lines in skin     M =  1.7779E-02
Parameter "a" in the expression f*(phi +a*phi**3) = -2.5408E-01
Amplitude  f  in the expression f*(phi +a*phi**3) =  5.6578E-02
Normal displacement amplitude between stringers W =  4.2203E-02
Number of axial halfwaves at local bifurcation    =     6
Number of axial halfwaves in postbuckled regime   =  7.0295E+00
Convergence characteristic,               NOCONV  =  0


RESULTS FOR  7.0295E+00 AXIAL WAVES...
LOCAL DEFORMATION PARAMETERS:
   SLOPE, a, f       =  1.7779E-02 -2.5408E-01  5.6578E-02
APPLIED STRESS RESULTANTS (Load set A):
   Nx, Ny, Nxy       = -1.0000E+03  0.0000E+00  5.0000E+00
APPLIED STRESS RESULTANTS (Load set B):
  Nxo, Nyo, Nxyo     =  0.0000E+00  0.0000E+00  0.0000E+00
STRAIN AND STRESS FROM APPLIED LOADS:
AVERAGE STRAIN COMPONENTS:
  EPS1, EPS2, EPS12  = -2.5757E-03  1.2504E-05  9.2303E-05
AVERAGE RESULTANTS IN SKIN:
N1SKIN,N2SKIN,N12SKIN= -3.6157E+02 -6.1694E+00  5.0000E+00
NOTE: N1SKIN includes average of Nx in skin and stringer base.


TANGENT STIFFNESS AFTER SYMMETRIZATION
AVERAGE SKIN TANGENT STIFFNESS MATRIX
(Segments 1 and 2 averaged),    CTAN...
 1.0686E+05 -1.8410E+04  1.0187E+03
-1.8410E+04  2.0729E+05  2.6206E+03
 1.0187E+03  2.6206E+03  5.4195E+04

(APPLIED LOAD)/(BUCKLING LOAD)=  3.1855E+00

NORMALIZED AVERAGE SKIN TANGENT STIFFNESS MATRIX
(CTAN(i,i)/CX(i,i,1), i=1,2,3) =   3.9883E-01  7.7364E-01  5.7791E-01
```

```
 TANGENT POISSON RATIO
 CTAN(1,2)/CTAN(1,1) =  -1.7228E-01
 NORMALIZED AVERAGE (N1skin,N12skn) COUPLING
 CTAN(1,3)/CX(1,1,1) =   3.8020E-03
 NORMALIZED AVERAGE (N2skin,N12skn) COUPLING
 CTAN(2,3)/CX(2,2,1) =   9.7806E-03
 ***** END SUBROUTINE KOIT2 (KOITER THEORY POSTBUCKLING) ******
 ********** END OF NONLINEAR EQUILIBRIUM CALCS.************
 **** CHAPTER 17: DESIGN PERTURBATION INDEX, IMOD=  0 *****
 Margin=  1.1273E-01  eff.stress:matl=1,SKN,Dseg=2,node=6,layer=1,z=0.0121; MID.;FS=1.
 Margin=  1.6689E+04  stringer popoff margin:(allowable/actual)-1, web 1  MID.;FS=1.

***** BEGIN SUBROUTINE STRCON (STRESSES IN RINGS) ******
 Margin=  2.1026E+00  eff.stress:matl=1,STR,Iseg=3,at:TIP,layer=1,z=0.;-MID.;FS=1.
 ***** END   SUBROUTINE STRCON (STRESSES IN RINGS) ******
 **** CHAPTER 18: DESIGN PERTURBATION INDEX, IMOD=  0 *****

 *** BEGIN SUBROUTINE LOCAL (HI-M POST-POSTBUCKLING SEARCH) ***
 Buckling load factor from SUB. LOCAL, EIGITR(6)=  1.2059E+00
 Number of axial halfwaves between rings,NPP=   12
  **** END SUBROUTINE LOCAL (HI-M POST-POSTBUCKLING SEARCH) ****

 **** BEGIN SUBROUTINE  MODE (HI-M POST-POSTBUCKLING MODE) ****
  **** END SUBROUTINE  MODE (HI-M POST-POSTBUCKLING MODE) ****
 Margin=  2.0589E-01  Hi-axial-wave post-post-buckling of module - 1;   M=12 ;FS=1.

*** BEGIN SUBROUTINE DEFCIJ (POST-LOCALLY BUCKLED CS(I,J)) ****
 Effective stiffnesses of undeformed and of
 locally deformed module segments:
                                                              Undeformed   Deformed
     Effective axial stiffness of panel SKIN + BASE =  2.6794E+05  1.1726E+05
     Effective hoop  stiffness of panel SKIN + BASE =  2.6794E+05  2.0716E+05
     Effective (1,2) stiffness of panel SKIN + BASE =  8.0382E+04  6.5050E+03
     Effective axial stiffness of stringer   WEB    =  8.8888E+05  8.8693E+05
     Effective axial stiffness of stringer   FLANGE =  0.0000E+00  0.0000E+00
     Effective shear stiffness of panel SKIN + BASE =  9.3778E+04  5.4161E+04
     Effective shear stiffness of stringer   WEB    =  3.1111E+05  3.1111E+05
     Effective shear stiffness of stringer   FLANGE =  0.0000E+00  0.0000E+00

 Integrated stringer stiffnesses...
     Effective axial stiffness of stringer,   STIFL =  2.7682E+05
     Effective first moment, Int[STIF*zdz],   STIFM =  1.2051E+05
     Effective second moment,Int[STIF*z**2dz],STIFMM=  6.9016E+04

 Constitutive law, CS(i,j), for locally deformed
 panel with smeared stringers and rings.....
       3.9574E+05  6.3523E+03  0.0000E+00  1.2051E+05  0.0000E+00  0.0000E+00
       6.3523E+03  2.5971E+05  0.0000E+00  0.0000E+00  2.2892E+04  0.0000E+00
       0.0000E+00  0.0000E+00  5.4161E+04  0.0000E+00  0.0000E+00  0.0000E+00
       1.2051E+05  0.0000E+00  0.0000E+00  6.9029E+04  3.9038E+00  0.0000E+00
       0.0000E+00  2.2892E+04  0.0000E+00  3.9038E+00  1.3128E+04  0.0000E+00
       0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  6.7649E+01

 Constitutive law, C(i,j), for locally deformed
 panel between rings with smeared stringers.....
       3.9574E+05  6.3523E+03  0.0000E+00  1.2051E+05  0.0000E+00  0.0000E+00
       6.3523E+03  2.0716E+05  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
       0.0000E+00  0.0000E+00  5.4161E+04  0.0000E+00  0.0000E+00  0.0000E+00
```

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       1.2051E+05  0.0000E+00  0.0000E+00  6.9029E+04  3.9038E+00  0.0000E+00
       0.0000E+00  0.0000E+00  0.0000E+00  3.9038E+00  1.3013E+01  0.0000E+00
       0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  6.1574E+01
 *** END   SUBROUTINE DEFCIJ (POST-LOCALLY BUCKLED CS(I,J)) ****
 **** CHAPTER 19: DESIGN PERTURBATION INDEX, IMOD=  0 *****
*** END SUBROUTINE BUCKLE (WIDE-COLUMN BUCKLING - MODULE) ****

*** BEGIN SUBROUTINE MODE (WIDE-COLUMN BUCKLING MODE SHAPE) ****
 *** END SUBROUTINE MODE (WIDE-COLUMN BUCKLING MODE SHAPE) ****

  WIDE COLUMN PANEL BUCKLING LOAD FACTOR =          2.8643E+00
 ISKIN = 0. WIDE COLUMN BUCKLING IS IGNORED IF ISKIN = 1.
 IWIDE = 0. WIDE COLUMN BUCKLING IS IGNORED IF IWIDE = 0.
 ITIP  = 0. MODE OF BUCKLING IS STRINGER SIDESWAY IF ITIP=1
 **** CHAPTER 20: DESIGN PERTURBATION INDEX, IMOD=  0 *****
 Number of axial halfwaves=  1; Buckling load factor=  1.4116E+00
 Number of axial halfwaves=  2; Buckling load factor=  1.1974E+00
 Number of axial halfwaves=  3; Buckling load factor=  1.0679E+00
 Margin=  1.9860E-01  (m=2   lateral-torsional buckling load factor)/(FS)-1;FS=0.999
 **** CHAPTER 23: DESIGN PERTURBATION INDEX, IMOD=  0 ****
 Margin=  2.1026E+00  eff.stress:matl=1,STR,Iseg=3,at:TIP,layer=1,z=0.;-MID.;FS=1.
 **** CHAPTER 24: DESIGN PERTURBATION INDEX, IMOD=  0 ****
 **** CHAPTER 25: DESIGN PERTURBATION INDEX, IMOD=  0 ****
 Margin=  1.0083E+00  buckling margin stringer Iseg.3 . Local halfwaves=4  .MID.;FS=1.
 Margin=  3.3774E+01  buckling margin   ring   Iseg.3 . Local halfwaves=1  .MID.;FS=1.
 ***** END   SUBROUTINE STFEIG (BUCKLING IN STIFFENERS) ******

***** BEGIN SUBROUTINE STFEIG (NO POSTBUCKLING EFFECT) ******
 Margin=  1.2706E+00  buckling margin stringer Iseg.3 . Local halfwaves=4  .NOPO;FS=1.
 Margin=  3.3774E+01  buckling margin   ring   Iseg.3 . Local halfwaves=1  .NOPO;FS=1.
 ******* END SUBROUTINE STFEIG (NO POSTBUCKLING EFFECT) ******
 **** CHAPTER 26: DESIGN PERTURBATION INDEX, IMOD=  0 ****

 Sanders theory is used for these buckling calculations in this case.
 Local buckling load factors & mode shapes before any knockdown factors applied:
 EIGMNC=  4.94E-01  1.00E+17  3.44E-01  1.00E+17  1.00E+17  1.11E+00  1.00E+17
 SLOPEX=  2.00E-02  0.00E+00  1.00E-02  0.00E+00  0.00E+00  5.00E-02  0.00E+00
 MWAVEX=    2         0         4         0         0         1         0
 NWAVEX=    1         0         1         0         0         1         0
 NOTE: The buckling nodal line slopes, SLOPEX, are as
 defined in Fig. 9a or Fig. 9b of the 1987 "Theoretical
 basis of the PANDA...",if NWAVEX > 0; that is, there
 has not yet been any inversion of SLOPEX when 9b holds.

 LOCAL BUCKLING FROM PANDA-TYPE THEORY [1B] AFTER KNOCKDOWN FOR t.s.d.:
 EIGLOC =   3.4372E-01(m=   4,n=   1)
 Margin=  7.0260E-01  buck.(SAND);simp-support smear string;M=1;N=1;slope=0.;FS=0.999

 Entering ALTSOL: radius, axial, circ. dimensions =  1.5755E+05  9.7793E+00  1.2352E+01
 See ITEMs 438, 444  in the file ..panda2/doc/panda2.news .
 and AIAA paper 99-1233, Proc. 40th AIAA SDM Meeting, 1999
 pp 302-345, especially pp 304-316 and associated figures.
 ***INTER-RING BUCKLING, N-STRINGER-BAY PATCH, SMEARED SUBSTF **
         Number of discrete stringers, rings: NUMSTR, NUMRNG=  0  0

 No alternative solution sought because user did not want one.
 (IALTSN was set equal to zero in MAINSETUP)
```

```
Entering ALTSOL: radius, axial, circ. dimensions =  1.5755E+05  9.7793E+00  1.2352E+01
See ITEMs 438, 444  in the file ..panda2/doc/panda2.news .
and AIAA paper 99-1233, Proc. 40th AIAA SDM Meeting, 1999
pp 302-345, especially pp 304-316 and associated figures.
*** GENERAL BUCKLING, N x M BAY PATCH, SMEARED SUBSTIFFRS ***
        Number of discrete stringers, rings: NUMSTR, NUMRNG=  0  0

No alternative solution sought because user did not want one.
(IALTSN was set equal to zero in MAINSETUP)
General buckling loads AFTER knockdown for t.s.d.
Number of circumferential halfwaves in buckling pattern=  1.0000E+00
Buckling load factor BEFORE knockdown for smeared stringers=  3.7443E+00
Buckling load factor AFTER  knockdown for smeared stringers=  3.5114E+00

General buckling load factor before and after knockdown:
EIGGEN(before modification by 5 factors below)     =  3.5114E+00
Knockdown factor from modal imperfection(s)        =  1.0000E+00
Knockdown factor for smearing rings on cyl. shell  =  1.0000E+00
Knockup factor to avoid twice accounting for t.s.d.=  1.0000E+00
1st modifying factor, FKNMOD=1 or 1/(EIG9X*FMDKD9) =  1.0000E+00
2nd modifying factor, EIGMR9=1 or EIGGNX/EIGGEN    =  1.0000E+00
After knockdn,EIGGEN*FKNOCK(9)*(RNGKNK/SHRFCT)*FKNMOD*EIGMR9=  3.5114E+00
in which
EIG9X  = lambda(ARBOCZ)/lambda(original PANDA-type theory)=  1.0000E+00
      lambda(ARBOCZ)=perfect panel buckling from ARBOCZ theory
      lambda(PANDA) =perfect panel buckling from PANDA  theory
FMDKD9 = 1 or 0.9/EIG9X =  0.0000E+00
EIGGNX = eigenvalue for perfect panel from alternate solution
Margin=  2.5149E+00  buck.(SAND);simp-support general buck;M=1;N=1;slope=0.;FS=0.999

Smeared stringer with rolling before and after knockdown:
EIGRSS(before knockdown by 2 factors below)        =  1.7016E+00
Knockdown factor from inter-ring modal imperfection=  1.0000E+00
Modifying factor, FKNMOD=1 or 1/(EIG8X*FMDKD8)     =  1.0000E+00
After knockdown, EIGRSS*FKNOCK(8)*FKNMOD           =  1.7016E+00
in which
EIG8X  = lambda(ARBOCZ)/lambda(original PANDA-type theory)=  1.0000E+00
      lambda(ARBOCZ)=perfect panel buckling from ARBOCZ theory
      lambda(PANDA) =perfect panel buckling from PANDA  theory
FMDKD8 = 1 or 0.9/EIG8X =  0.0000E+00
Margin=  7.0332E-01  buck.(SAND);rolling with smear string;M=1;N=1;slope=0.;FS=0.999
Margin=  7.0372E+01  buck.(SAND);rolling with smear rings; M=14;N=1;slope=0.;FS=0.1
Margin=  2.2632E+00  buck.(SAND);rolling only of stringers;M=7;N=0;slope=0.;FS=1.4

Stringer rolling from PANDA-type theory [1B]:
PANDA-type buckling load factor, EIGRLL(2)(m,n,slope)=  4.5684E+00(   7,0,0)
****  END SUBROUTINE BUCPAN (PANDA-TYPE BUCKLING LOADS) ****
*** END   SUBROUTINE BUCPAN (PANDA-TYPE BUCKLING LOADS) ****
Margin=  3.8724E+02  (Max.allowable ave.axial strain)/(ave.axial strain) -1; FS=1.
**** CHAPTER 27: DESIGN PERTURBATION INDEX, IMOD=  0 ****

Objective (weight of PANDA2 model of panel), OBJ =  6.8621E-01
**** CHAPTER 28: DESIGN PERTURBATION INDEX, IMOD=  0 ****

ANALYSIS: ITYPE=2;  IQUICK=0;  LOAD SET 1;  SUBCASE 1:
LOADING: Nx, Ny, Nxy, Mx, My =  -1.00E+03  0.00E+00  5.00E+00  0.00E+00  0.00E+00
         Nxo, Nyo, pressure  =   0.00E+00  0.00E+00  0.00E+00
BUCKLING LOAD FACTORS FOR LOCAL BUCKLING FROM KOITER v. BOSOR4 THEORY:
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  Local buckling load factor from KOITER theory =  3.1393E-01 (flat skin)
  Local buckling load factor from BOSOR4 theory =  3.1982E-01 (flat skin)
0
 MARGINS FOR CURRENT DESIGN: LOAD CASE NO. 1, SUBCASE NO. 1
 MAR. MARGIN
 NO.  VALUE                DEFINITION
 1  2.20E+00 Local buckling from discrete model-1.,M=6   axial halfwaves;FS=0.1
 2  2.14E+00 Local buckling from Koiter theory,M=6   axial halfwaves;FS=0.1
 3  1.13E-01 eff.stress:matl=1,SKN,Dseg=2,node=6,layer=1,z=0.0121; MID.;FS=1.
 4  1.67E+04 stringer popoff margin:(allowable/actual)-1, web 1  MID.;FS=1.
 5  2.10E+00 eff.stress:matl=1,STR,Iseg=3,at:TIP,layer=1,z=0.;-MID.;FS=1.
 6  2.06E-01 Hi-axial-wave post-post-buckling of module - 1;   M=12 ;FS=1.
 7  1.99E-01 (m=2   lateral-torsional buckling load factor)/(FS)-1;FS=0.999
 8  2.10E+00 eff.stress:matl=1,STR,Iseg=3,at:TIP,layer=1,z=0.;-MID.;FS=1.
 9  1.01E+00 buckling margin stringer Iseg.3 . Local halfwaves=4  .MID.;FS=1.
10  3.38E+01 buckling margin   ring   Iseg.3 . Local halfwaves=1  .MID.;FS=1.
11  1.27E+00 buckling margin stringer Iseg.3 . Local halfwaves=4  .NOPO;FS=1.
12  3.38E+01 buckling margin   ring   Iseg.3 . Local halfwaves=1  .NOPO;FS=1.
13  7.03E-01 buck.(SAND);simp-support smear string;M=1;N=1;slope=0.;FS=0.999
14  2.51E+00 buck.(SAND);simp-support general buck;M=1;N=1;slope=0.;FS=0.999
15  7.03E-01 buck.(SAND);rolling with smear string;M=1;N=1;slope=0.;FS=0.999
16  7.04E+01 buck.(SAND);rolling with smear rings; M=14;N=1;slope=0.;FS=0.1
17  2.26E+00 buck.(SAND);rolling only of stringers;M=7;N=0;slope=0.;FS=1.4
18  3.87E+02 (Max.allowable ave.axial strain)/(ave.axial strain) -1; FS=1.
 ***********  ALL 1 LOAD SETS PROCESSED  ***********
 *****************************************************


 **** WARNING ******** WARNING ******** WARNING ****
 THERE IS SOME POSITIVE MARGIN FOR GENERAL INSTABILITY AND THE
 STRINGER SPACING IS NOT AT ITS LOWER BOUND.  IF YOU HAVE RUN
 PANDAOPT MANY TIMES IN SUCCESSION IN ORDER TO GET AN OPTIMUM
 DESIGN, YOU MAY BE NEAR A LOCAL OPTIMUM BUT MAYBE NOT A GLOBAL
 OPTIMUM. USE "CHANGE" TO RESET THE STRINGER SPACING b TO A
 SMALLER VALUE.  ALSO, POSSIBLY USE "DECIDE" TO RESET THE
 LOWER BOUND OF THE STRINGER SPACING b TO A SMALLER VALUE.
 THEN PERFORM MORE "PANDAOPTs".

 *** NOTE 1: IT IS OFTEN A GOOD IDEA NOT TO HAVE THE STRINGER
           SPACING AS A DECISION VARIABLE, BUT TO PERFORM
           OPTIMIZATIONS FOR SEVERAL DIFFERENT FIXED STRINGER
           SPACINGS.

 *** NOTE 2: IF THE PANEL IS IMPERFECT OR HAS LOW STRESS ALLOW-
           IT IS LIKELY THAT AT THE GLOBAL OPTIMUM DESIGN THE
           GENERAL AND/OR INTER-RING BUCKLING LOAD MARGINS ARE
           NOT CRITICAL. THEN PLEASE DISREGARD THIS WARNING.
 *** END WARNING ******** END WARNING ******** END WARNING ***

0
          SUMMARY OF INFORMATION FROM OPTIMIZATION ANALYSIS
 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  2.00E+00 2.4705E+00  1.00E+01
B(STR):stiffener spacing, b: STR seg=NA, layer=NA
   2   N     N     Y      1    3.33E-01  0.00E+00 8.2342E-01  0.00E+00
B2(STR):width of stringer base, b2 (must be > 0, see
   3   Y     N     N      0    0.00E+00  1.00E-01 8.4714E-01  3.00E+00
```

```
H(STR):height of stiffener (type H for sketch), h:
   4   Y     Y     N      0    0.00E+00  1.00E-02 2.4141E-02  5.00E-01    T(1
)(SKN):thickness for layer index no.(1 ): SKN seg=1
   5   Y     Y     N      0    0.00E+00  1.00E-02 8.0087E-02  5.00E-01    T(2
)(STR):thickness for layer index no.(2 ): STR seg=3
   6   Y     N     N      0    0.00E+00  3.00E+00 9.7793E+00  1.30E+01
B(RNG):stiffener spacing, b: RNG seg=NA, layer=NA
   7   N     N     N      0    0.00E+00  0.00E+00 0.0000E+00  0.00E+00
B2(RNG):width of ring base, b2 (zero is allowed): RN
   8   N     N     Y      3    1.00E+00  0.00E+00 8.4714E-01  0.00E+00
H(RNG):height of stiffener (type H for sketch), h:
   9   Y     Y     N      0    0.00E+00  2.00E-02 6.0060E-02  2.00E-01    T(3
)(RNG):thickness for layer index no.(3 ): RNG seg=3
0
   CURRENT VALUE OF THE OBJECTIVE FUNCTION:
 VAR. STR/ SEG. LAYER   CURRENT
 NO.  RNG  NO.   NO.     VALUE           DEFINITION
            0     0   6.862E-01   WEIGHT OF THE ENTIRE PANEL

  TOTAL WEIGHT OF SKIN                           =   2.9162E-01
  TOTAL WEIGHT OF SUBSTIFFENERS                  =   0.0000E+00
  TOTAL WEIGHT OF STRINGERS                      =   3.3174E-01
  TOTAL WEIGHT OF RINGS                          =   6.2849E-02
  SPECIFIC WEIGHT (WEIGHT/AREA) OF STIFFENED PANEL=   5.6806E-03
 IN ORDER TO AVOID FALSE CONVERGENCE OF THE DESIGN, BE SURE TO
 RUN  PANDAOPT  MANY TIMES DURING AN OPTIMIZATION. INSPECT THE
 allenflat.OPP  FILE AFTER EACH OPTIMIZATION RUN. OR BETTER YET,
 RUN SUPEROPT.
 **** NOTE: It is almost always best to set the number of ****
 **** iterations per execution of "PANDAOPT" equal to 5   ****
 **** in response to the following prompt in "MAINSETUP": ****
 "How many design iterations permitted in this run (5 to 25)?"
 **** Hence, the *.OPT file should almost always have the ****
 **** following line in it:                               ****
 "5   $ How many design iterations in this run (5 to 25)?"
 ******************** END OF allenflat.OPM FILE *****************
======================================================================
```