Same as previous Fig (zoomed)

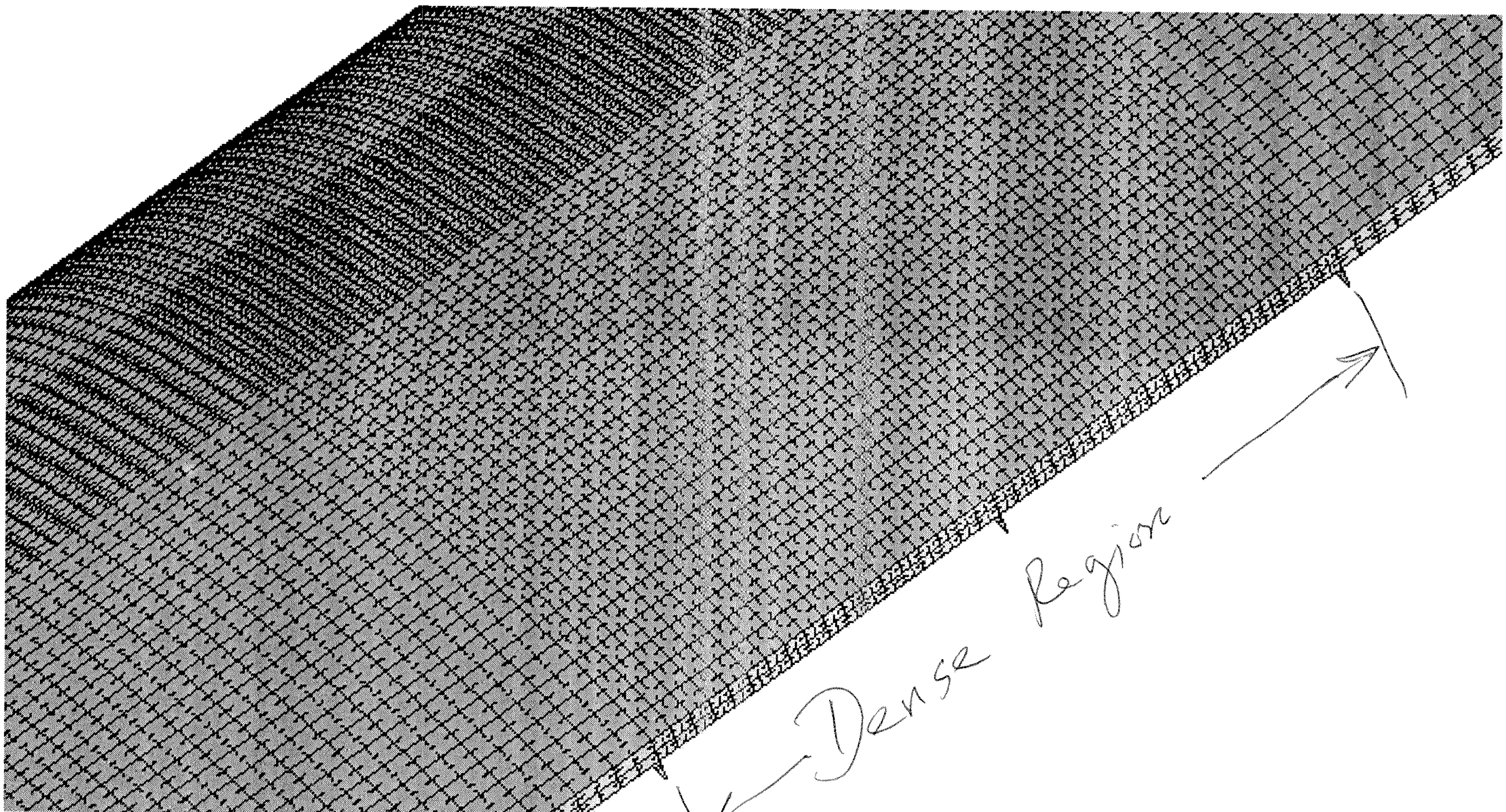


Fig. 65

Table 6.4 Abridged output from 3 STAGS linear buckling runs to find general buckling mode.

nasaortholin1.out2.nonuniform.all

OUTPUT FROM STAGS FOR LINEAR BUCKLING RUNS
IN SEARCH OF THE GENERAL BUCKLING MODE AND
LOAD FACTOR: ILIN = 1. STAGS 60-DEGREE x 6-RING-BAY MODEL
WITH NONUNIFORM MESH

==

1 nasaortho.out2 (abridged, model with nonuniform mesh
shift = 2.608979, 750 negative roots
CONVERGENCE HAS BEEN OBTAINED FOR EIGENVALUES 1 THROUGH 8

CRITICAL LOAD FACTOR COMBINATION

NO.	EIGENVALUE	LOAD SYSTEM A	LOAD SYSTEM B	@DOF	root
1	2.603670E+00	2.603670E+00	0.000000E+00	220761	746
2	2.606622E+00	2.606622E+00	0.000000E+00	151521	747
3	2.607646E+00	2.607646E+00	0.000000E+00	228465	748
4	2.608357E+00	2.608357E+00	0.000000E+00	215313	749
5	2.608586E+00	2.608586E+00	0.000000E+00	197169	750
6	2.609078E+00	2.609078E+00	0.000000E+00	232833	751
7	2.615415E+00	2.615415E+00	0.000000E+00	122505	752
8	2.615788E+00	2.615788E+00	0.000000E+00	230721	753

----

2 nasaortho.out2 (abridged, model with nonuniform mesh)
shift = 2.598, 740 negative roots
CONVERGENCE HAS BEEN OBTAINED FOR EIGENVALUES 1 THROUGH 8

CRITICAL LOAD FACTOR COMBINATION

NO.	EIGENVALUE	LOAD SYSTEM A	LOAD SYSTEM B	@DOF	root
1	2.595030E+00	2.595030E+00	0.000000E+00	115953	737
2	2.595705E+00	2.595705E+00	0.000000E+00	136833	738
3	2.596621E+00	2.596621E+00	0.000000E+00	136737	739
4	2.597070E+00	2.597070E+00	0.000000E+00	5757	740
5	2.598428E+00	2.598428E+00	0.000000E+00	137145	741
6	2.599055E+00	2.599055E+00	0.000000E+00	215385	742
7	2.599861E+00	2.599861E+00	0.000000E+00	116265	743
8	2.600248E+00	2.600248E+00	0.000000E+00	135345	744

----

3 nasaortho.out2 (abridged, model with nonuniform mesh)
shift = 2.600, 743 negative roots (go back to find root 745)
CONVERGENCE HAS BEEN OBTAINED FOR EIGENVALUES 1 THROUGH 8

CRITICAL LOAD FACTOR COMBINATION

NO.	EIGENVALUE	LOAD SYSTEM A	LOAD SYSTEM B	@DOF	root	
1	2.596621E+00	2.596621E+00	0.000000E+00	136737	739	
2	2.597070E+00	2.597070E+00	0.000000E+00	5853	740	
3	2.598428E+00	2.598428E+00	0.000000E+00	139497	741	
4	2.599055E+00	2.599055E+00	0.000000E+00	214377	742	
5	2.599861E+00	2.599861E+00	0.000000E+00	116265	743	
6	2.600248E+00	2.600248E+00	0.000000E+00	214377	744	
7	2.601934E+00	2.601934E+00	0.000000E+00	255697	745	<--general buckling
8	2.603670E+00	2.603670E+00	0.000000E+00	128961	746	

STAGS Model with the non-uniform mesh

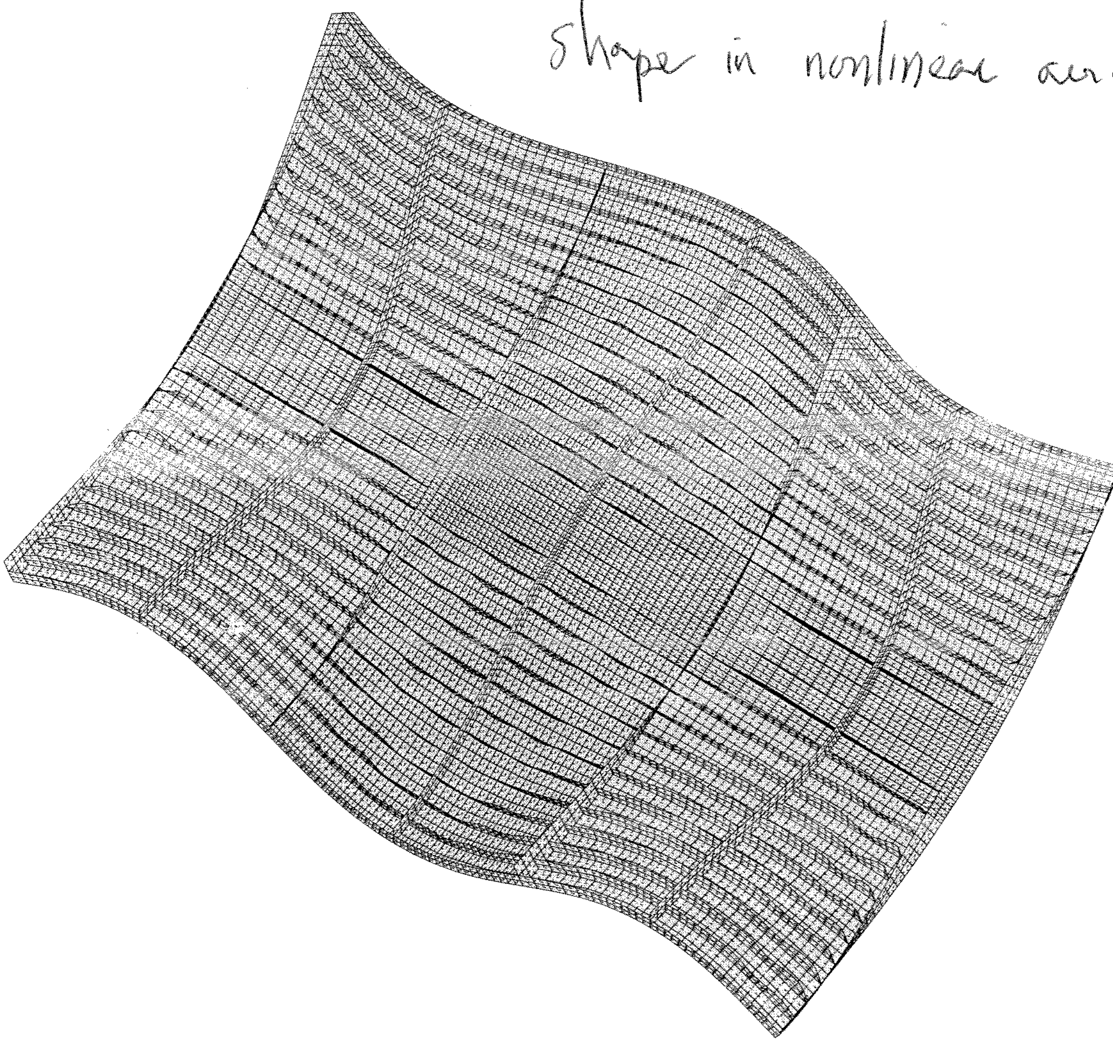
Table 65 nasaortho.bin

```
nasaortho STAGS INPUT FOR STIFFENED CYL.(STAGSUNIT=SHELL UNITS)
1, $ INDIC=1 is bifur.buckling; INDIC=3 is nonlinear BEGIN B-1
1, $ IPOST=1 means save displacements every IPOSTth step
0, $ ILIST =0 means normal batch-oriented output
0, $ ICOR  =0 means projection in; 1 means not in.
1, $ IMPTHE=index for imperfection theory.
0, $ ICHIST=index for crack archive option
0, $ IFLU  =0 means no fluid interaction.
-1 $ ISOLVR= 0 means original solver; -1 new solver.END B-1 rec
1.000E+00, $ STLD(1) = starting load factor, System A. BEGIN C-1 rec.
0.000E+00, $ STEP(1) = load factor increment, System A
1.000E+00, $ FACM(1) = maximum load factor, System A
0.000E+00, $ STLD(2) = starting load factor, System B
0.000E+00, $ STEP(2) = load factor increment, System B
0.000E+00, $ FACM(2) = maximum load factor, System B
0  $ ITEMP =0 means no thermal loads. END C-1 rec.
10000, $ NSEC= number of CPU seconds before run termination
0., $ DELEV is eigenvalue error tolerance (0=.00001)
0  $ IPRINT=0 means print modes, iteration data, END D-2 rec.
 1, $ NEIGS= number of eigenvalues sought.  BEGIN D-3 rec.
2.601934, $ SHIFT=initial eigenvalue shift
0.000E+00, $ EIGA =lower bound of eigenvalue range
0.000E+00  $ EIGB =upper bound of eigenvalue range.      END D-3 rec.
```

See bottom of Table 64

We start over now that we know exactly what the eigenvalue shift should be.

General Buckling Mode, to be used as an initial imperfection shape in nonlinear analysis.



solution scale = 0.4205E+01
mode 1, pcr = 0.26019E+01
step 0 eigenvector deformed geometry
linear buckling of perfect shell from STAGS

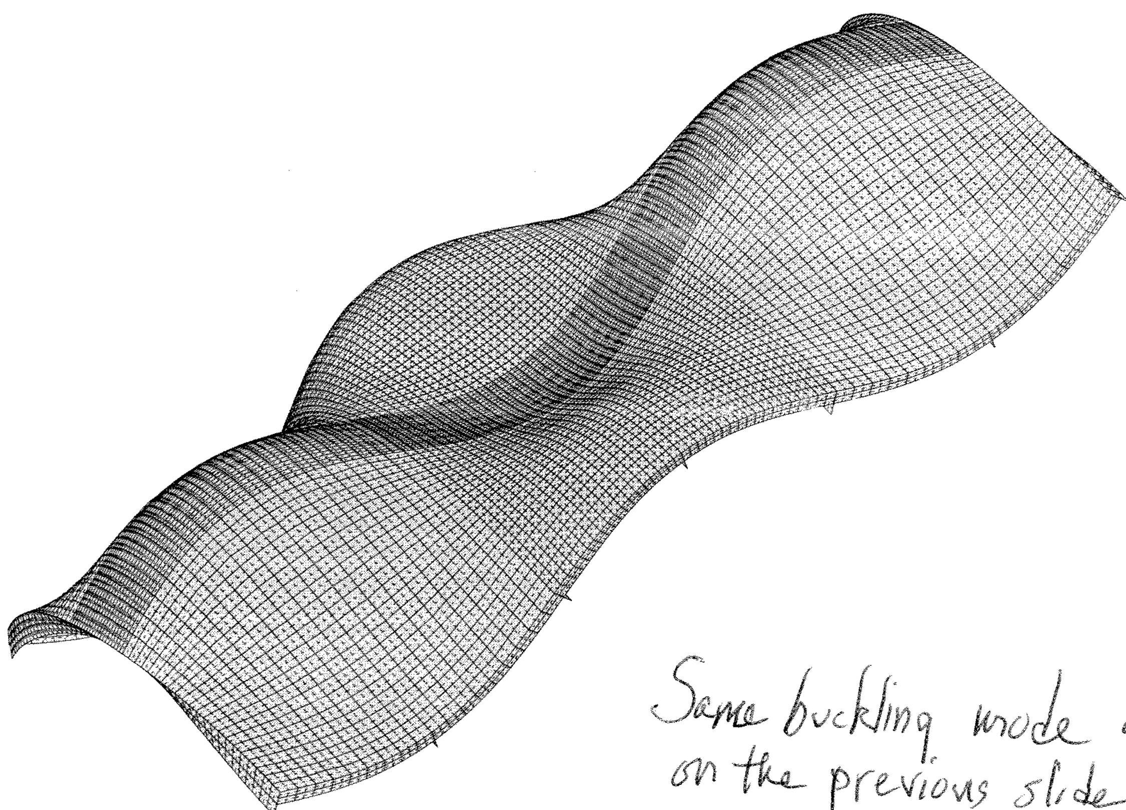
Θ x -35.84
Θ y -179.86
Θ z 35.63

x y z

1.336E+01

Fig. 66

Compare with Fig. 74



Same buckling mode as on the previous slide

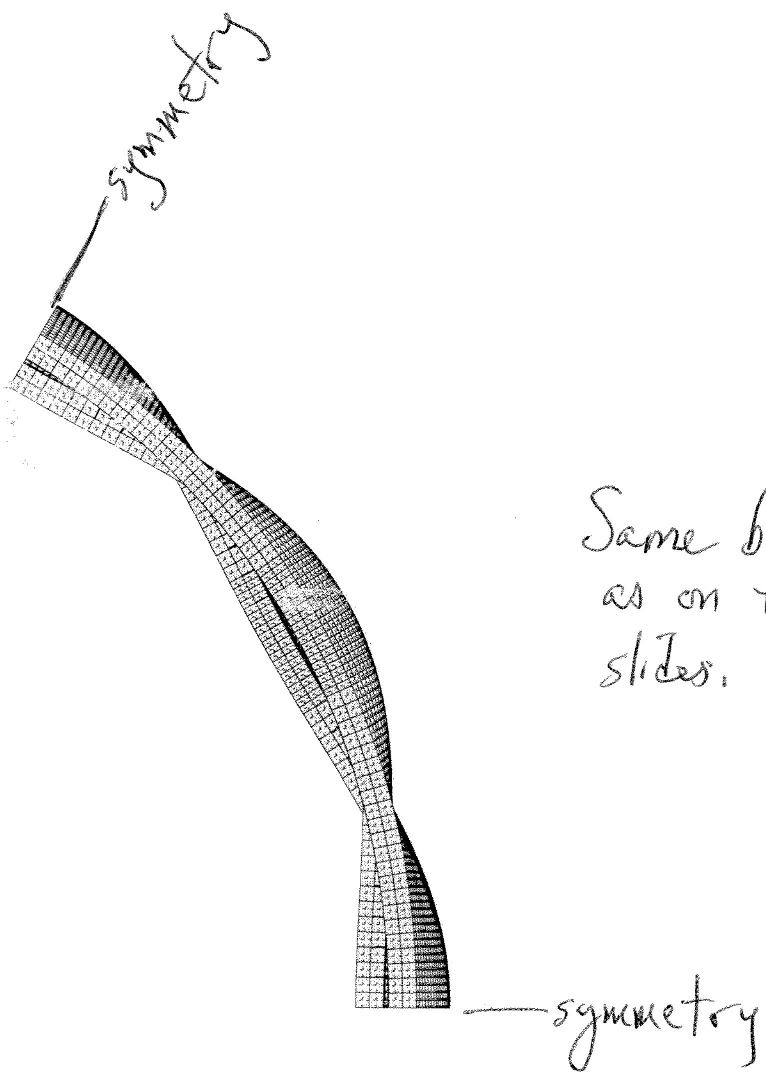
solution scale = 0.4521E+01
mode 1, $\boxed{\text{pcr = 0.26019E+01}}$
step 0 eigenvector deformed geometry
linear buckling of perfect shell from STAGS

Θ x -35.84
Θ y -13.14
Θ z 35.63

y z x

1.216E+01

Fig. 67



Same buckling mode as on the previous two slides.

solution scale = 0.2082E+01
mode 1, $\boxed{\text{pcr} = 0.26019\text{E}+01}$
step 0 eigenvector deformed geometry
linear buckling of perfect shell from STAGS

Θ x 0.00
Θ y 90.00
Θ z 0.00

y
x z

1.146E+01

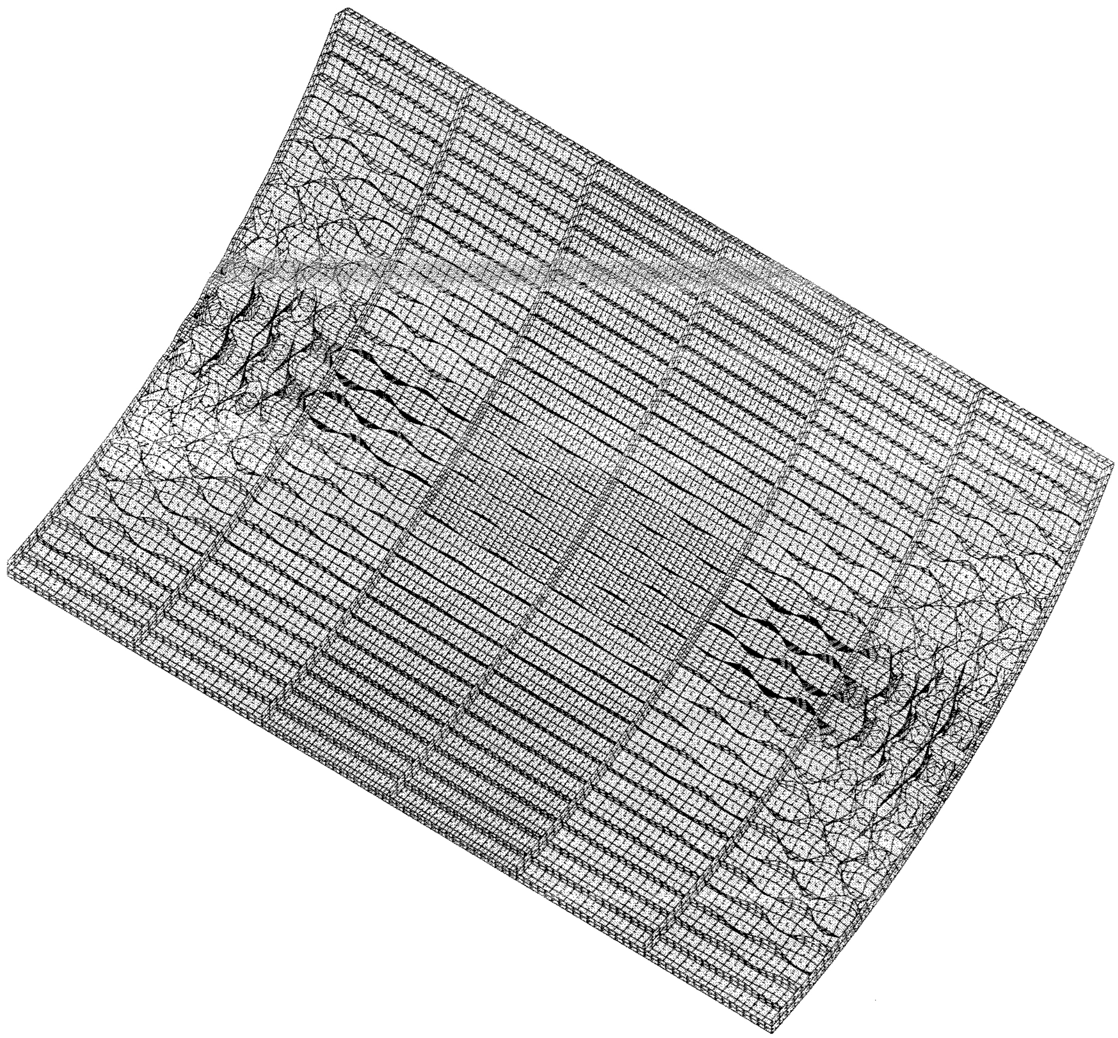
Fig. 68

Table 66 nasortho.STG (input for STAGSUNIT)

```
    n         $ Do you want a tutorial session and tutorial output?
       1      $ Choose type of STAGS analysis (1,3,4,5,6),INDIC
       0      $ Restart from ISTARTth load step (0=1st nonlinear soln), ISTART
 1.000000     $ Local buckling load factor from PANDA2, EIGLOC
    y         $ Are the dimensions in this case in inches?
       0      $ Nonlinear (0) or linear (1) kinematic relations?, ILIN
       0      $ Type 1 for closed (360-deg) cyl. shell, 0 otherwise, ITOTAL
 68.75000     $ X-direction length of the STAGS model of the panel: XSTAGS
 50.26548     $ Panel length in the plane of the screen, L2
    n         $ Is the nodal point spacing uniform along the stringer axis?
 22.91667     $ Axial callout X(i) where the nodal point spacing changes, X( 1)
      37      $ Number of nodes n(i) from X(i-1) to X(i) (n=odd!), n( 1)
    y         $ Are there any more interior axial stations x where dx changes?
 45.83333     $ Axial callout X(i) where the nodal point spacing changes, X( 2)
      73      $ Number of nodes n(i) from X(i-1) to X(i) (n=odd!), n( 2)
    n         $ Are there any more interior axial stations x where dx changes?
      37      $ Number of nodes n(i) from last X to x = XSTAGS, n( 3)
   -2219      $ Resultant (e.g. lb/in) normal to the plane of screen, Nx
       0      $ Resultant (e.g. lb/in) in the plane of the screen,    Ny
       0      $ In-plane shear in load set A,                        Nxy
       0      $ Normal pressure in STAGS model in Load Set A, p
       0      $ Resultant (e.g. lb/in) normal to the plane of screen, Nx0
       0      $ Resultant (e.g. lb/in) in the plane of the screen,    Ny0
       0      $ Normal pressure in STAGS model in Load Set B, p0
       1      $ Starting load factor for Load System A, STLD(1)
       0      $ Load factor increment for Load System A, STEP(1)
       1      $ Maximum load factor for Load System A, FACM(1)
       0      $ Starting load factor for Load System B, STLD(2)
       0      $ Load factor increment for Load System B, STEP(2)
       0      $ Maximum load factor for Load System B, FACM(2)
       8      $ How many eigenvalues do you want? NEIGS
     480      $ Choose element type (410 or 411 or 480) for panel skin
    n         $ Have you obtained buckling modes from STAGS for this case?
     162      $ Number of stringers in STAGS model of 360-deg. cylinder
       7      $ Number of rings in the STAGS model of the panel
    y         $ Are there rings at the ends of the panel?
       0      $ Number of finite elements between adjacent stringers
     100      $ Number of finite elements over circumference, NELCIR
       9      $ Number of finite elements between adjacent rings
       3      $ Stringer model: 1 or 2 or 3 or 4 or 5(Type H(elp))
       3      $ Ring model: 1 or 2 or 3 or 4 or 5 (Type H(elp))
      -1      $ Reference surface of cyl: 1=outer, 0=middle, -1=inner
    n         $ Do you want to use fasteners (they are like rigid links)?
    n         $ Are the stringers to be "smeared out"?
    n         $ Is the nodal point spacing uniform around the circumference?
 24.44444     $ Circ. callout Y(i) where the nodal point spacing changes, Y( 1)
      45      $ Number of nodes n(i) from Y(i-1) to Y(i) (n=odd!), n( 1)
    y         $ Are there any more interior axial stations y where dy changes?
 35.55555     $ Circ. callout Y(i) where the nodal point spacing changes, Y( 2)
      41      $ Number of nodes n(i) from Y(i-1) to Y(i) (n=odd!), n( 2)
    n         $ Are there any more interior axial stations y where dy changes?
      45      $ Number of nodes n(i) from last Y to y = YSTAGS, n( 3)
    n         $ Are the rings to be "smeared out"?
       5      $ Number of nodes over height of stiffener webs, NODWEB
       3      $ Number of nodes over width of stringer flange, NDFLGS
       3      $ Number of nodes over width of ring flange, NDFLGR
    y         $ Do you want stringer(s) with a high nodal point density?
      13      $ Number of a stringer to have high mesh density, NUMSTR
    y         $ Do you want to choose another stringer?
      14      $ Number of a stringer to have high mesh density, NUMSTR
    y         $ Do you want to choose another stringer?
      15      $ Number of a stringer to have high mesh density, NUMSTR
    y         $ Do you want to choose another stringer?
      16      $ Number of a stringer to have high mesh density, NUMSTR
    n         $ Do you want to choose another stringer?
    n         $ Do you want ring(s) with a high nodal point density?
    n         $ Is there plasticity in this STAGS model?
    y         $ Do you want to use the "least-squares" model for torque?
    y         $ Is stiffener sidesway permitted at the panel edges?
    y         $ Do you want symmetry conditions along the straight edges?
```

note

ILIN=0 must be used for local buckling and for nonlinear analysis.



solution scale = 0.4627E+01
mode 1, pcr = 0.13506E+01
step 0 eigenvector deformed geometry
linear buckling of perfect shell from STAGS

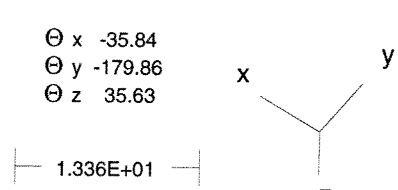
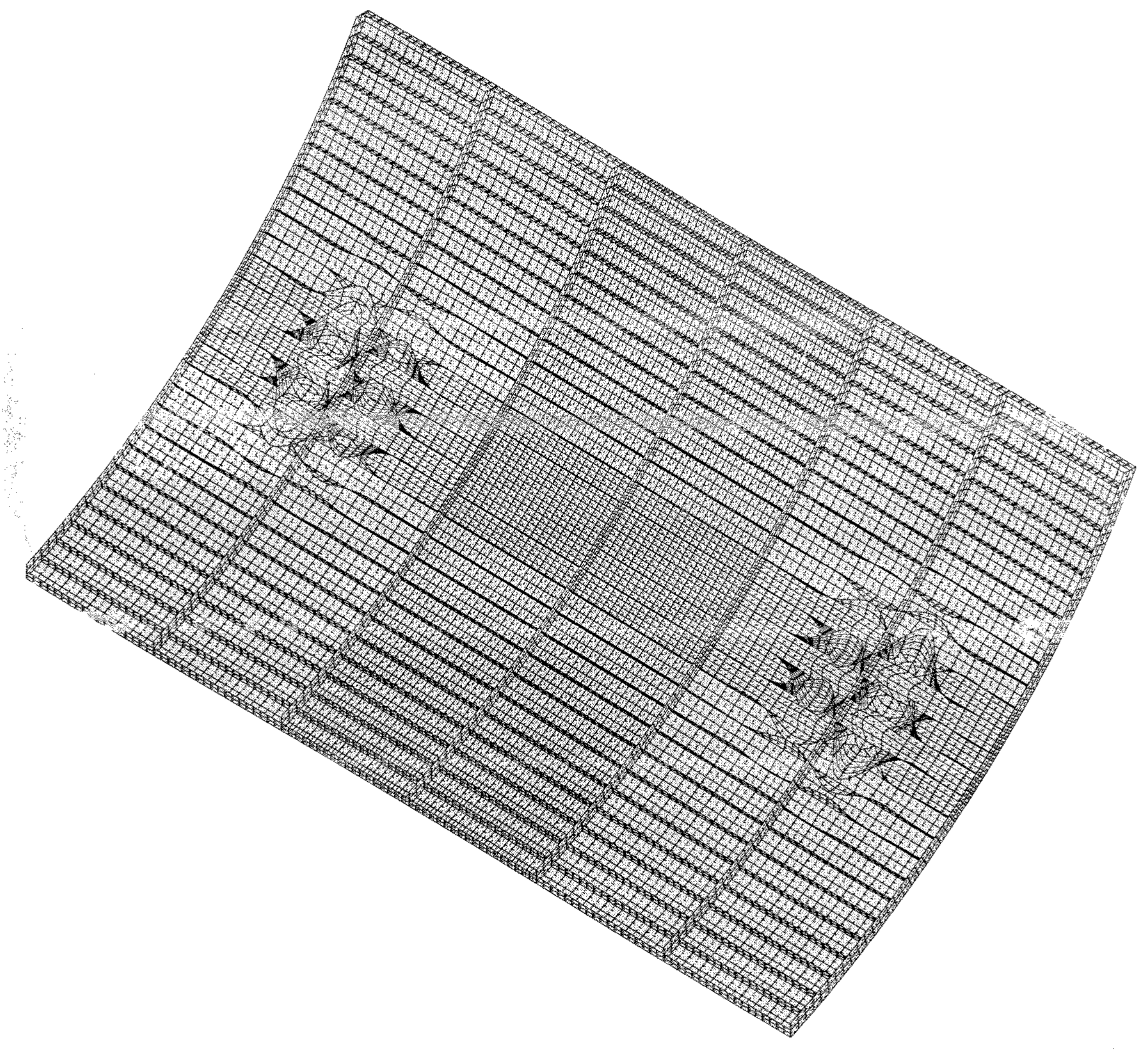


Fig. 69

Nonlinear buckling at Load Step 9
(PA=1.0)



solution scale = 0.4615E+01
mode 1, pcr = 0.10430E+01
step 9 eigenvector deformed geometry
linear buckling of perfect shell from STAGS

Θ x -35.84
Θ y -179.86
Θ z 35.63

x y z

1.336E+01

Fig. 70

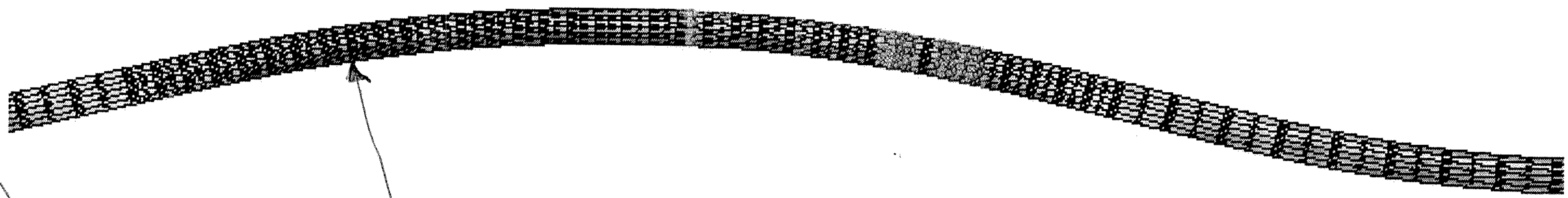


Fig. 71

185

02

).00000E+00 PX= 0.00000E+00

PA=1.0

 า ,seff, layer 1, inner fiber

inner fiber same view a linear buckling m

E+04, Maximum value = 3.28577E+04

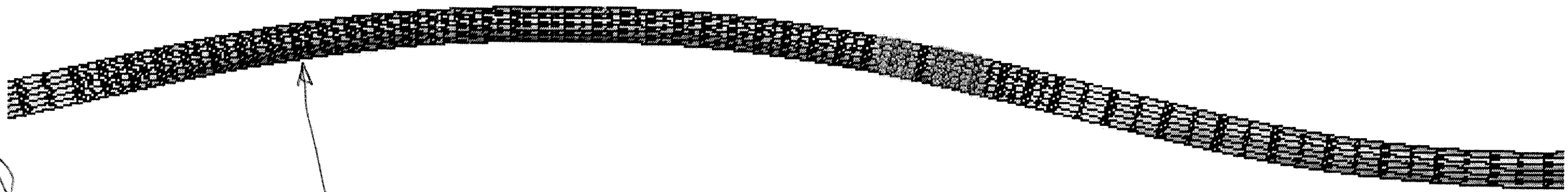


Fig. 72

186

2

PA=1.0

00000E+00 PX= 0.00000E+00

,seff, layer 1, outer fiber

uter fiber same view a linear buckling mc

+04, Maximum value = 3.31805E+04

Table 67 nasatho, STG

```
    n        $ Do you want a tutorial session and tutorial output?
    1        $ Choose type of STAGS analysis (1,3,4,5,6),INDIC
    0        $ Restart from ISTARTth load step (0=1st nonlinear soln), ISTART
 1.000000    $ Local buckling load factor from PANDA2, EIGLOC
    y        $ Are the dimensions in this case in inches?
    1        $ Nonlinear (0) or linear (1) kinematic relations?, ILIN
    0        $ Type 1 for closed (360-deg) cyl. shell, 0 otherwise, ITOTAL
 68.75000    $ X-direction length of the STAGS model of the panel: XSTAGS
 50.26548    $ Panel length in the plane of the screen, L2
    n        $ Is the nodal point spacing uniform along the stringer axis?
 22.91667    $ Axial callout X(i) where the nodal point spacing changes, X( 1)
   37        $ Number of nodes n(i) from X(i-1) to X(i) (n=odd!), n( 1)
    y        $ Are there any more interior axial stations x where dx changes?
 45.83333    $ Axial callout X(i) where the nodal point spacing changes, X( 2)
   73        $ Number of nodes n(i) from X(i-1) to X(i) (n=odd!), n( 2)
    n        $ Are there any more interior axial stations x where dx changes?
   37        $ Number of nodes n(i) from last X to x = XSTAGS, n( 3)
 -2219       $ Resultant (e.g. lb/in) normal to the plane of screen, Nx
    0        $ Resultant (e.g. lb/in) in the plane of the screen,    Ny
    0        $ In-plane shear in load set A,                        Nxy
    0        $ Normal pressure in STAGS model in Load Set A, p
    0        $ Resultant (e.g. lb/in) normal to the plane of screen, Nx0
    0        $ Resultant (e.g. lb/in) in the plane of the screen,    Ny0
    0        $ Normal pressure in STAGS model in Load Set B, p0
    1        $ Starting load factor for Load System A, STLD(1)
    0        $ Load factor increment for Load System A, STEP(1)
    1        $ Maximum load factor for Load System A, FACM(1)
    0        $ Starting load factor for Load System B, STLD(2)
    0        $ Load factor increment for Load System B, STEP(2)
    0        $ Maximum load factor for Load System B, FACM(2)
    8        $ How many eigenvalues do you want? NEIGS
  480        $ Choose element type (410 or 411 or 480) for panel skin
    n        $ Have you obtained buckling modes from STAGS for this case?
  162        $ Number of stringers in STAGS model of 360-deg. cylinder
    7        $ Number of rings in the STAGS model of the panel
    y        $ Are there rings at the ends of the panel?
    0        $ Number of finite elements between adjacent stringers
  100        $ Number of finite elements over circumference, NELCIR
    9        $ Number of finite elements between adjacent rings
    3        $ Stringer model: 1 or 2 or 3 or 4 or 5(Type H(elp))
    3        $ Ring model: 1 or 2 or 3 or 4 or 5 (Type H(elp))
   -1        $ Reference surface of cyl: 1=outer, 0=middle, -1=inner
    n        $ Do you want to use fasteners (they are like rigid links)?
    n        $ Are the stringers to be "smeared out"?
    n        $ Is the nodal point spacing uniform around the circumference?
 24.44444    $ Circ. callout Y(i) where the nodal point spacing changes, Y( 1)
   45        $ Number of nodes n(i) from Y(i-1) to Y(i) (n=odd!), n( 1)
    y        $ Are there any more interior axial stations y where dy changes?
 35.55555    $ Circ. callout Y(i) where the nodal point spacing changes, Y( 2)
   41        $ Number of nodes n(i) from Y(i-1) to Y(i) (n=odd!), n( 2)
    n        $ Are there any more interior axial stations y where dy changes?
   45        $ Number of nodes n(i) from last Y to y = YSTAGS, n( 3)
    n        $ Are the rings to be "smeared out"?
    5        $ Number of nodes over height of stiffener webs, NODWEB
    3        $ Number of nodes over width of stringer flange, NDFLGS
    3        $ Number of nodes over width of ring flange, NDFLGR
    n        $ Do you want stringer(s) with a high nodal point density?
    n        $ Do you want ring(s) with a high nodal point density?
    n        $ Is there plasticity in this STAGS model?
    y        $ Do you want to use the "least-squares" model for torque?
    y        $ Is stiffener sidesway permitted at the panel edges?
    y        $ Do you want symmetry conditions along the straight edges?
```

input for STAGSUNIT

Table 68 (2 pages)

```
nasaortholin1.out2.nonuniform2.all

OUTPUT FROM STAGS FOR LINEAR BUCKLING RUNS
IN SEARCH OF THE GENERAL BUCKLING MODE AND
LOAD FACTOR: ILIN = 1. STAGS 60-DEGREE x 6-RING-BAY MODEL
WITH NONUNIFORM MESH and 5 nodal points across width of
ALL stringers.
=============================================================
1 nasaortho.out2 (abridged, model with nonuniform mesh)
shift = 2.601934, 734 negative roots
 CONVERGENCE HAS BEEN OBTAINED FOR EIGENVALUES  1 THROUGH   8
                    CRITICAL LOAD FACTOR COMBINATION
   NO.     EIGENVALUE   LOAD SYSTEM A  LOAD SYSTEM B    @DOF  root
     1   2.598371E+00   2.598371E+00   0.000000E+00  139809 733
     2   2.600594E+00   2.600594E+00   0.000000E+00  145761 734
     3   2.602351E+00   2.602351E+00   0.000000E+00  154641 735
     4   2.602422E+00   2.602422E+00   0.000000E+00  186537 736
     5   2.603468E+00   2.603468E+00   0.000000E+00  172761 737
     6   2.603567E+00   2.603567E+00   0.000000E+00   42135 738
     7   2.604802E+00   2.604802E+00   0.000000E+00  136737 739
     8   2.606142E+00   2.606142E+00   0.000000E+00  161481 740
------------------------------------------------------------------
2 nasaortho.out2 (abridged, model with nonuniform mesh)
shift = 2.595, 730 roots skipped
 CONVERGENCE HAS BEEN OBTAINED FOR EIGENVALUES  1 THROUGH   8
                    CRITICAL LOAD FACTOR COMBINATION
   NO.     EIGENVALUE   LOAD SYSTEM A  LOAD SYSTEM B    @DOF  root
     1   2.591336E+00   2.591336E+00   0.000000E+00  186633 726
     2   2.592291E+00   2.592291E+00   0.000000E+00   70143 727
     3   2.593686E+00   2.593686E+00   0.000000E+00  149217 728
     4   2.593722E+00   2.593722E+00   0.000000E+00  171993 729
     5   2.594828E+00   2.594828E+00   0.000000E+00  149889 730
     6   2.595248E+00   2.595248E+00   0.000000E+00   72963 731
     7   2.595544E+00   2.595544E+00   0.000000E+00  180177 732
     8   2.598371E+00   2.598371E+00   0.000000E+00  182073 733
------------------------------------------------------------------
3 nasaortho.out2 (abridged, model with nonuniform mesh)
          22           1     0.25873409E+01    0.10047905E+00         0.25873752E+01
          22           2     0.25882266E+01    0.72410242E-12         0.25882266E+01
          22           3     0.25856329E+01    0.45478781E-11         0.25856329E+01
          22           4     0.25832315E+01    0.10016660E-10         0.25832315E+01
          22           5     0.25828431E+01    0.47631545E-08         0.25828431E+01
          22           6     0.25913361E+01    0.46453469E-08         0.25913361E+01
          22           7     0.25922910E+01    0.11332715E-06         0.25922910E+01
          22           8     0.25812378E+01    0.66700105E-06         0.25812378E+01
          22           9     0.25936994E+01    0.37726863E-03         0.25936968E+01
          22          10     0.25937235E+01    0.20136934E-03         0.25937222E+01

shift - 2.587, 724 negative roots
MAXIMUM NUMBER OF ITERATIONS
 CONVERGENCE CRITERION HAS NOT BEEN SATISFIED FOR EIGENVALUES   1 THROUGH   8
                    CRITICAL LOAD FACTOR COMBINATION
   NO.     EIGENVALUE   LOAD SYSTEM A  LOAD SYSTEM B    @DOF
     1   2.581238E+00   2.581238E+00   0.000000E+00  159489 721
     2   2.582843E+00   2.582843E+00   0.000000E+00  203385 722
     3   2.583232E+00   2.583232E+00   0.000000E+00  116313 723
     4   2.585633E+00   2.585633E+00   0.000000E+00  119241 724
     5   2.587341E+00   2.587341E+00   0.000000E+00   66627     <--not converged
     6   2.588227E+00   2.588227E+00   0.000000E+00  203337 725
     7   2.591336E+00   2.591336E+00   0.000000E+00  135249 726
     8   2.592291E+00   2.592291E+00   0.000000E+00   42279 727
------------------------------------------------------------------
4 nasaortho.out2 (abridged, model with nonuniform mesh)
          22           1     0.26102443E+01    0.00000000E+00         0.26102443E+01
          22           2     0.26120537E+01    0.59001392E-11         0.26120537E+01
          22           3     0.26120585E+01    0.12585922E-11         0.26120585E+01
          22           4     0.26124634E+01    0.54621899E-10         0.26124634E+01
          22           5     0.26139468E+01    0.15381915E-08         0.26139468E+01
          22           6     0.26139518E+01    0.26770384E-07         0.26139518E+01
          22           7     0.26079914E+01    0.12103779E-10         0.26079914E+01
 root 740 22           8     0.26061421E+01    0.37639509E-03         0.26061402E+01
 root 748 22           9     0.26160020E+01    0.34009980E-04         0.26160022E+01
 root 749 22          10     0.26165517E+01    0.51472791E-03         0.26165545E+01
 root 750 22          11     0.26167729E+01    0.26095533E-03         0.26167744E+01

shift = 2.611, 742 negative roots
MAXIMUM NUMBER OF ITERATIONS
```

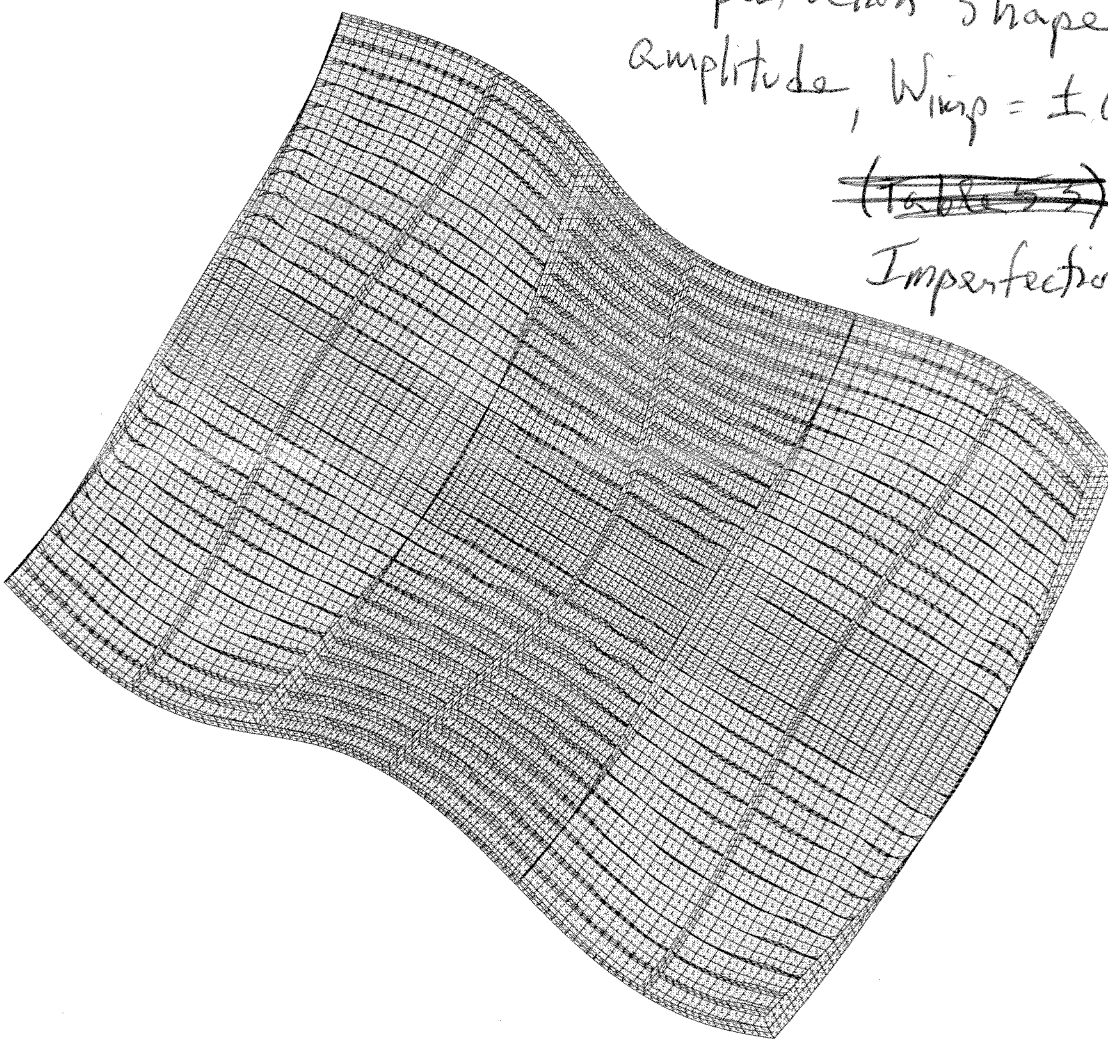
Table 68 (p. 2 of 2)

CONVERGENCE HAS BEEN OBTAINED FOR EIGENVALUES 1 THROUGH 7
CONVERGENCE CRITERION HAS NOT BEEN SATISFIED FOR EIGENVALUES 8 THROUGH 8

CRITICAL LOAD FACTOR COMBINATION

NO.	EIGENVALUE	LOAD SYSTEM A	LOAD SYSTEM B	@DOF	root	
1	~~2.606142E+00~~	2.606142E+00	0.000000E+00	161481	740	<--not converged
2	2.607991E+00	2.607991E+00	0.000000E+00	215089	741	<--general buckling
3	~~2.610244E+00~~	2.610244E+00	0.000000E+00	126465	742	
4	2.612054E+00	2.612054E+00	0.000000E+00	148329	743	
5	2.612059E+00	2.612059E+00	0.000000E+00	171537	744	
6	2.612463E+00	2.612463E+00	0.000000E+00	161721	745	
7	2.613947E+00	2.613947E+00	0.000000E+00	193449	746	
8	2.613952E+00	2.613952E+00	0.000000E+00	151617	747	

STAGS general Buckling with ILIN=1
(60-degree model)
Compare with Fig. ~~29~~ 66
Use as imperfection shape with amplitude, $W_{imp} = \pm 0.125''$
~~(Table 5.3)~~
Imperfection Shape #1



solution scale = 0.4206E+01
mode 1, pcr = 0.26080E+01 — compare with Fig. ~~29~~ 66
step 0 eigenvector deformed geometry
linear buckling of perfect shell from STAGS

Θ x -35.84
Θ y -179.86
Θ z 35.63

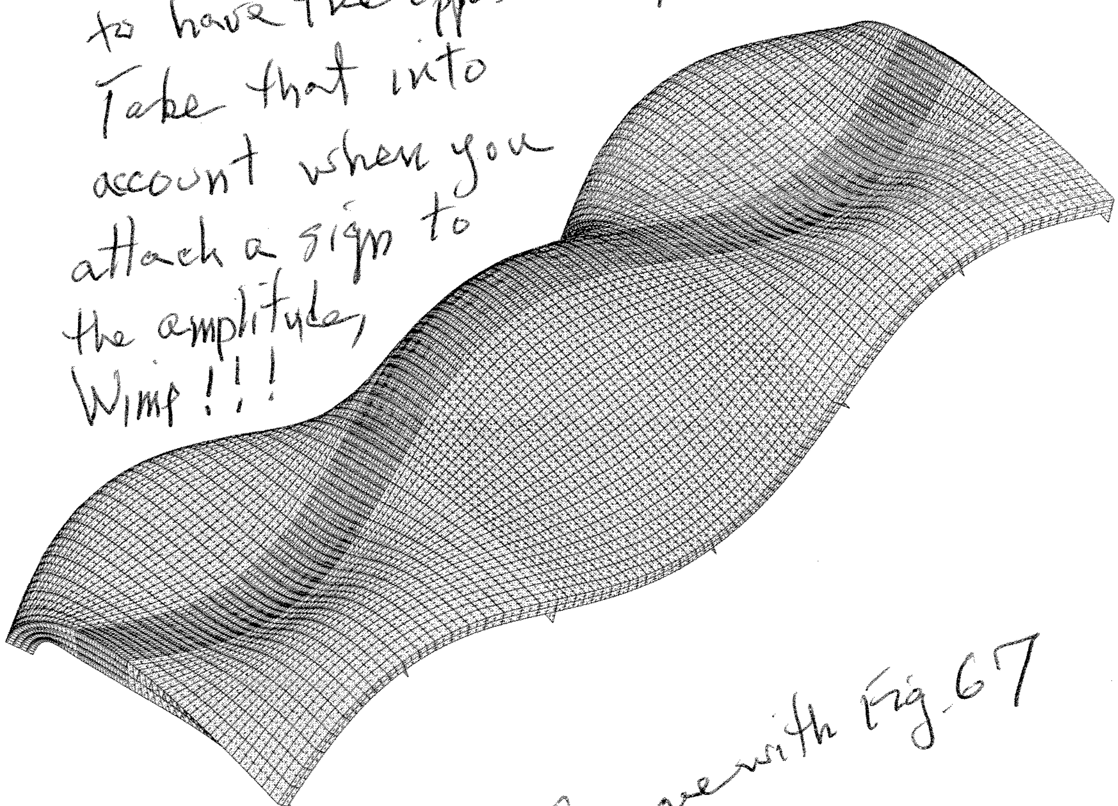
1.336E+01

x y z

Fig. 73

Compare with Fig. 67.

Notice that the buckling mode happens to have the opposite sign from that in Fig. 67. Take that into account when you attach a sign to the amplitude, Wimp!!!



Compare with Fig. 67

solution scale = 0.4513E+01
mode 1, $\boxed{\text{pcr} = 0.26080\text{E}+01}$
step 0 eigenvector deformed geometry
linear buckling of perfect shell from STAGS

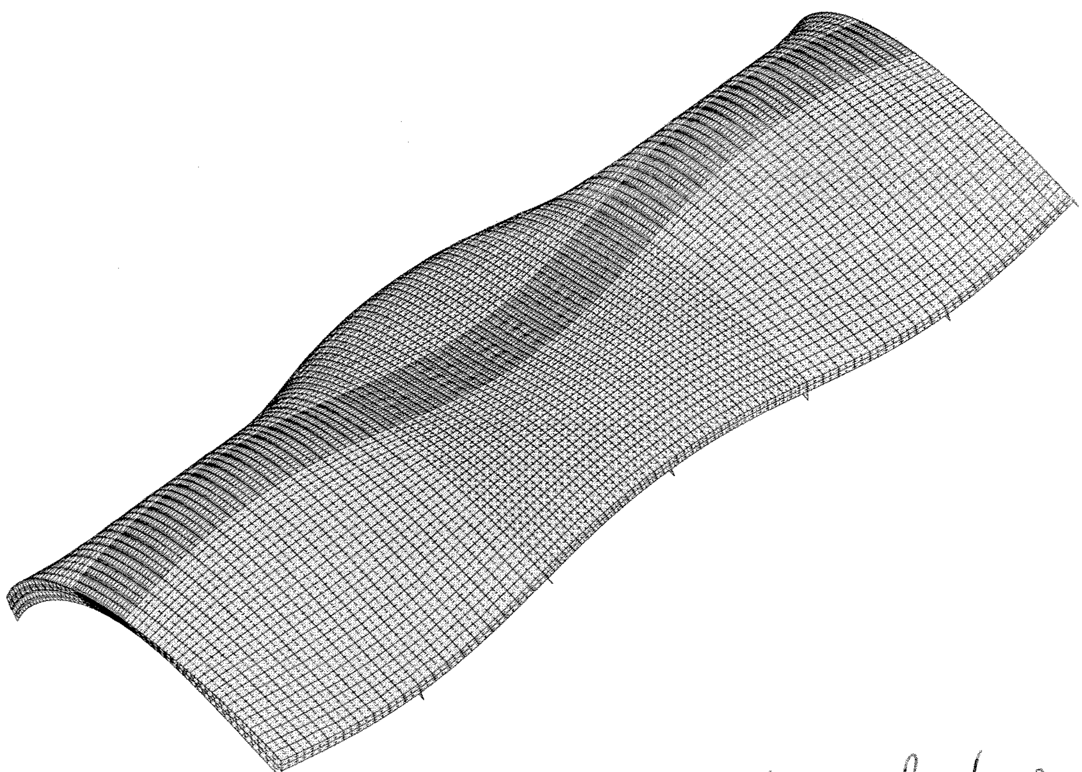
Θ x -35.84
Θ y -13.14
Θ z 35.63

y z x

1.216E+01

Fig. 74

$W_{imp} = -0.125''$



$PA = 1.0$ = the design load, $N_x = -2219$ lb/in

solution scale = 0.2327E+02
PA= 1.00000E+00 PB= 0.00000E+00 PX= 0.00000E+00
step 12 displacement deformed geometry
STAGS model: nonlinear deformation, same view as linear buckling modes

Θ x -35.84
Θ y -13.14
Θ z 35.63

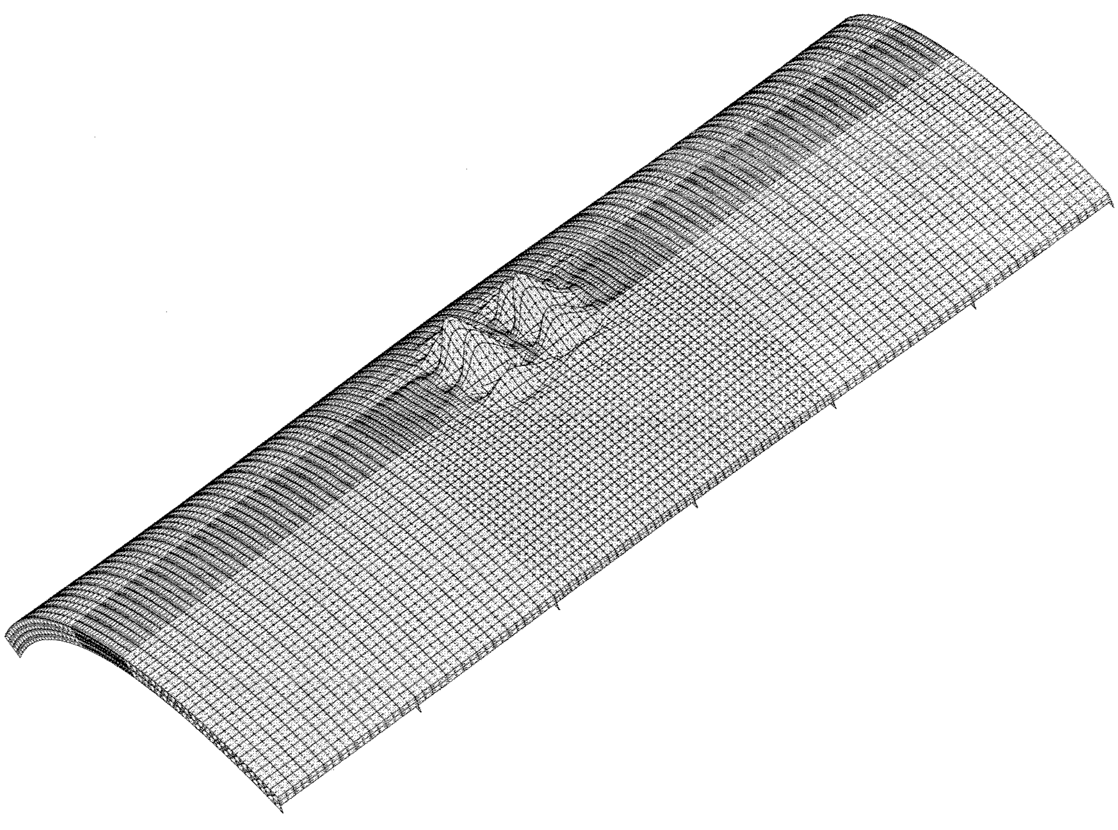
y z x

1.216E+01

Fig. 75

$W_{imp} = -0.125''$

Nonlinear local buckling
at the design load, PA=1.0



solution scale = 0.4003E+01
mode 1, pcr = 0.10402E+01
step 12 eigenvector deformed geometry
nonlinear local buckling of imperfect shell from STAGS

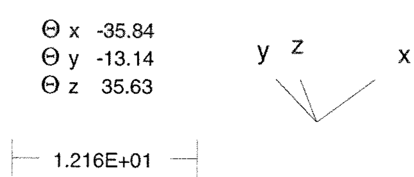
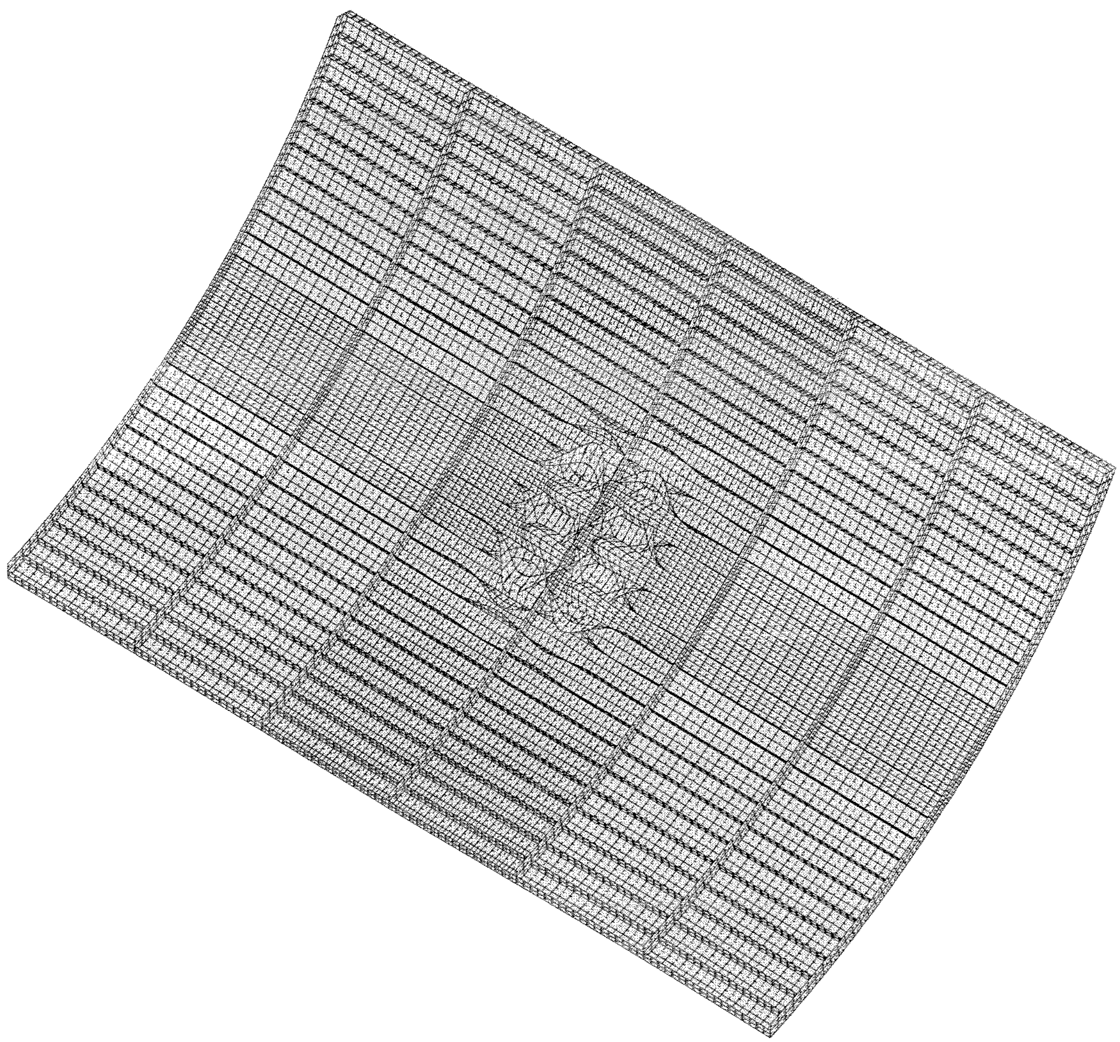


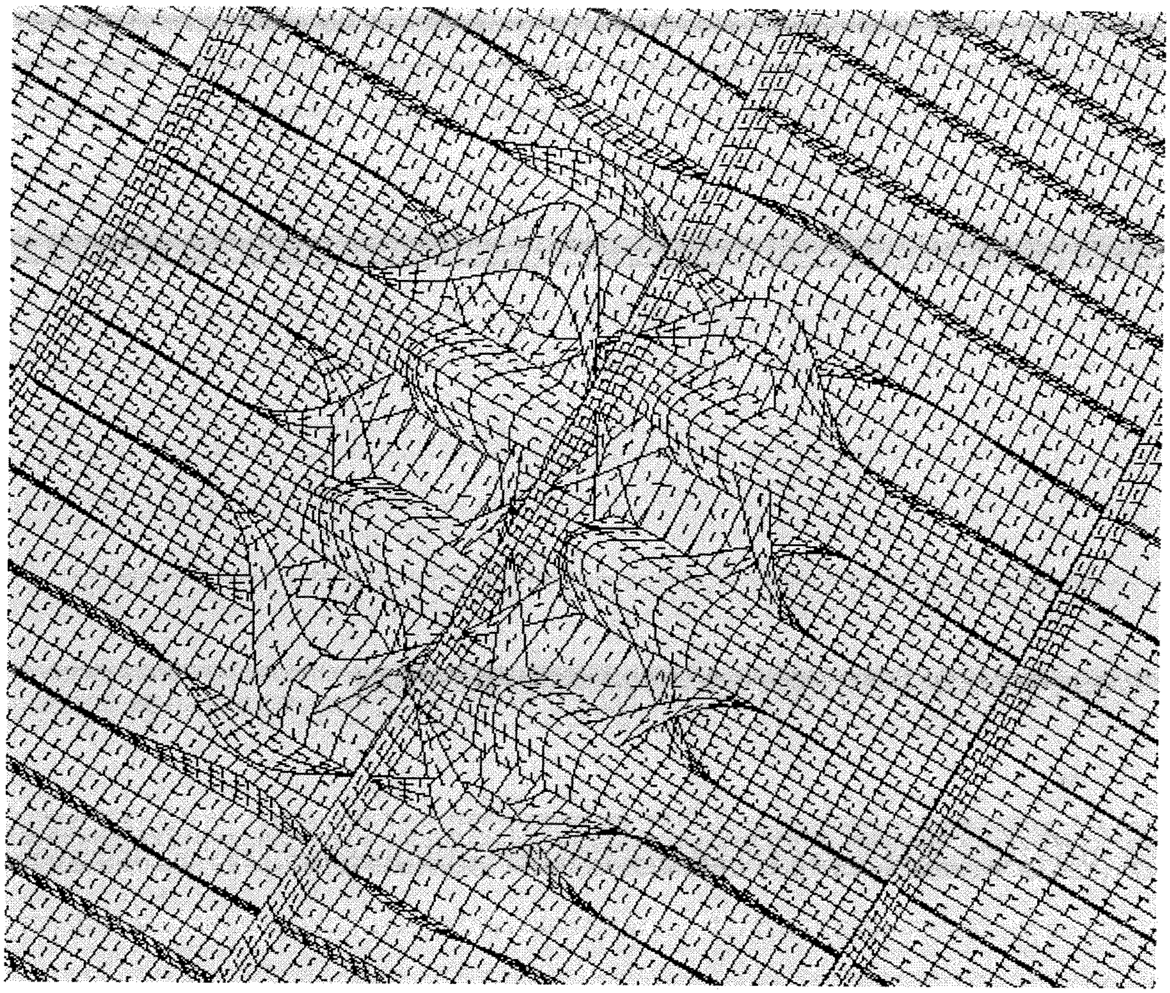
Fig. 76

Same buckling mode as in the previous figure



solution scale = 0.4615E+01
mode 1, pcr = 0.10402E+01
step 12 eigenvector deformed geometry
nonlinear local buckling of imperfect shell from STAGS

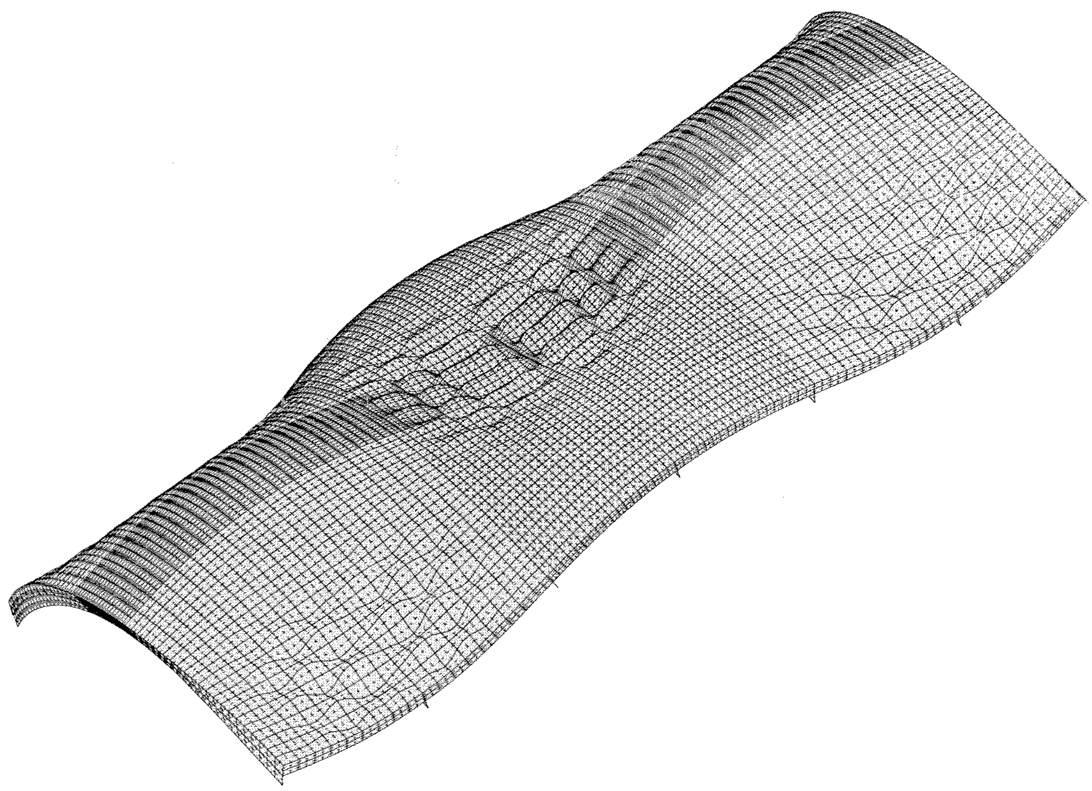
Fig. 77



Same buckling mode as in the previous figure

Fig. 78

Nonlinear Equilibrium at the highest load factor, PA, in Fig. 87



solution scale = 0.1424E+02
PA= 1.27518E+00 PB= 0.00000E+00 PX= 0.00000E+00
step 30 displacement deformed geometry
STAGS model: nonlinear deformation, same view as linear buckling modes

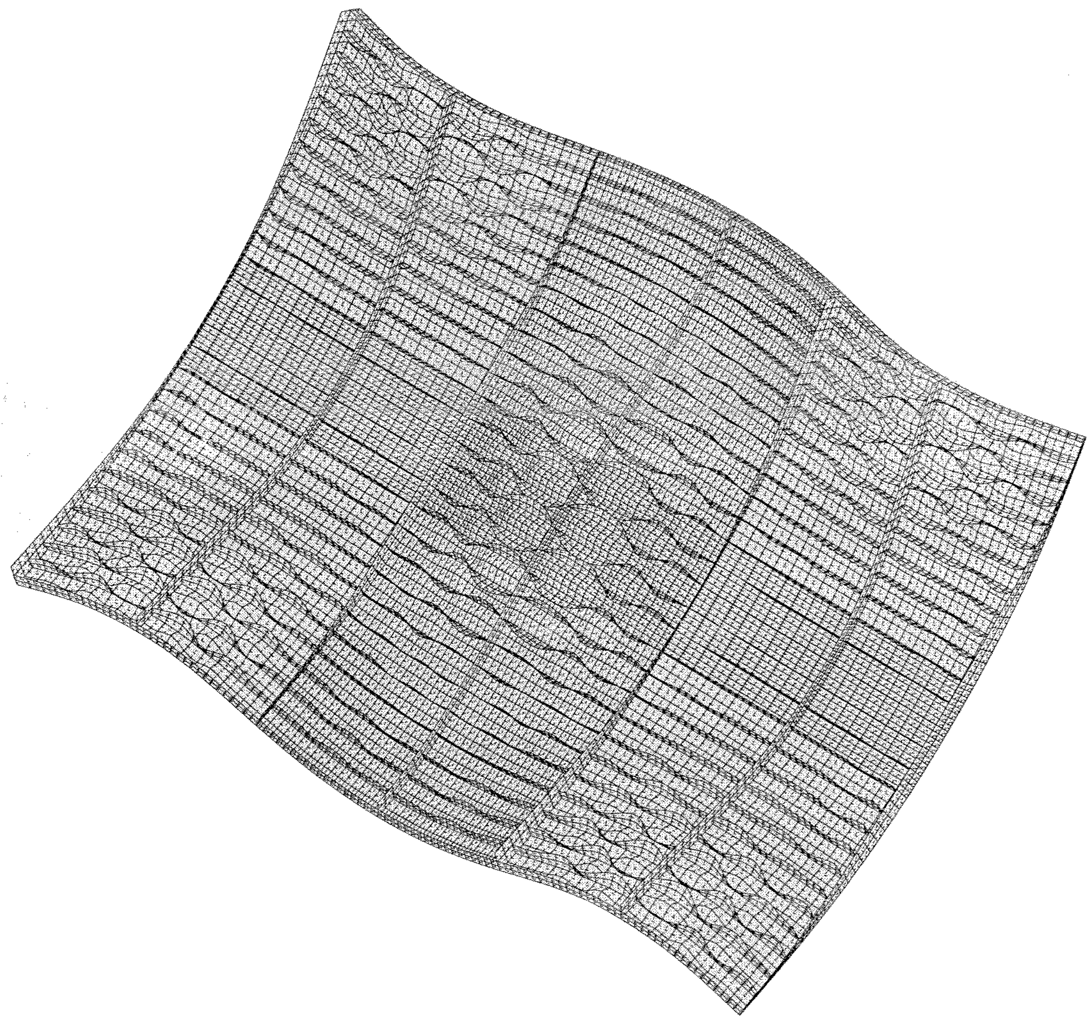
Θ x -35.84
Θ y -13.14
Θ z 35.63

y z x

1.216E+01

Fig. 79

Same nonlinear state as is shown in the previous Figure.



solution scale = 0.1652E+02

PA= 1.27518E+00 PB= 0.00000E+00 PX= 0.00000E+00

step 30 displacement deformed geometry

STAGS model: nonlinear deformation, same view as linear buckling modes

Θ x -35.84
Θ y -179.86
Θ z 35.63

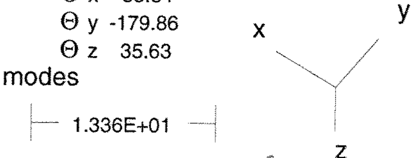
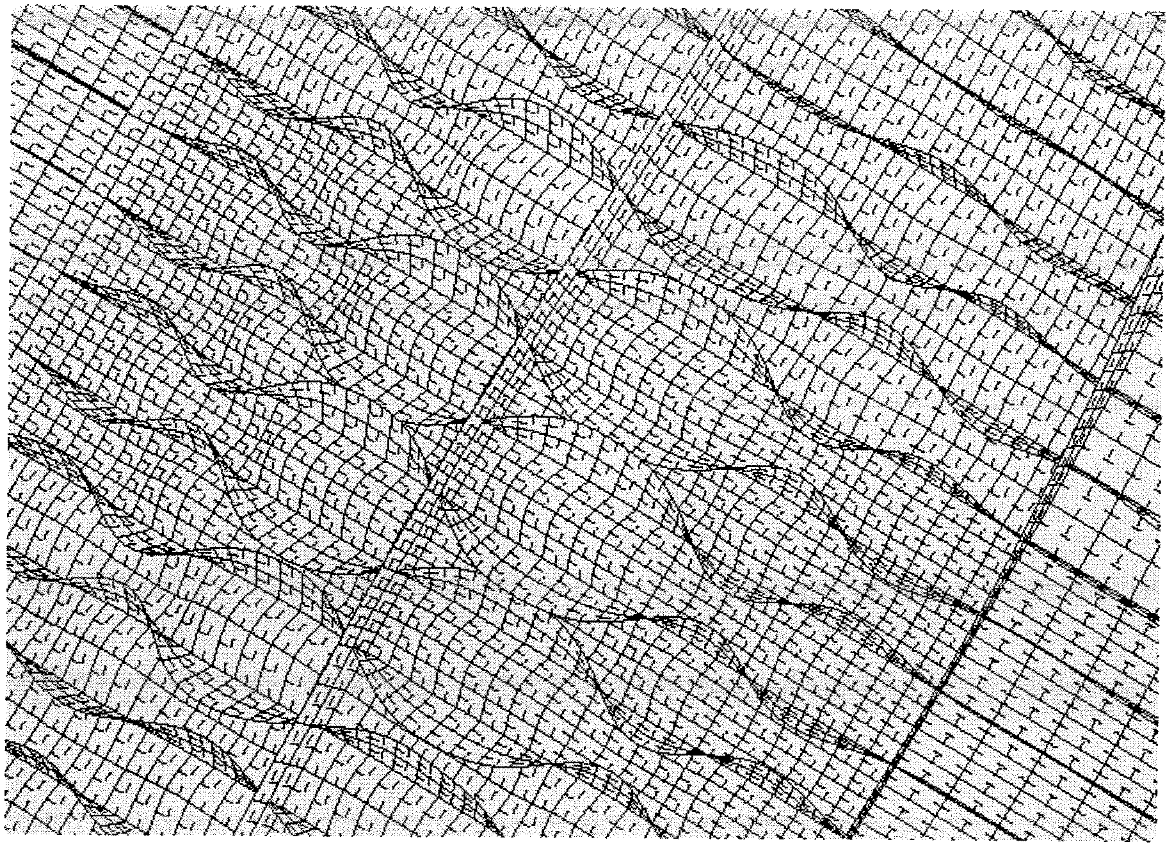
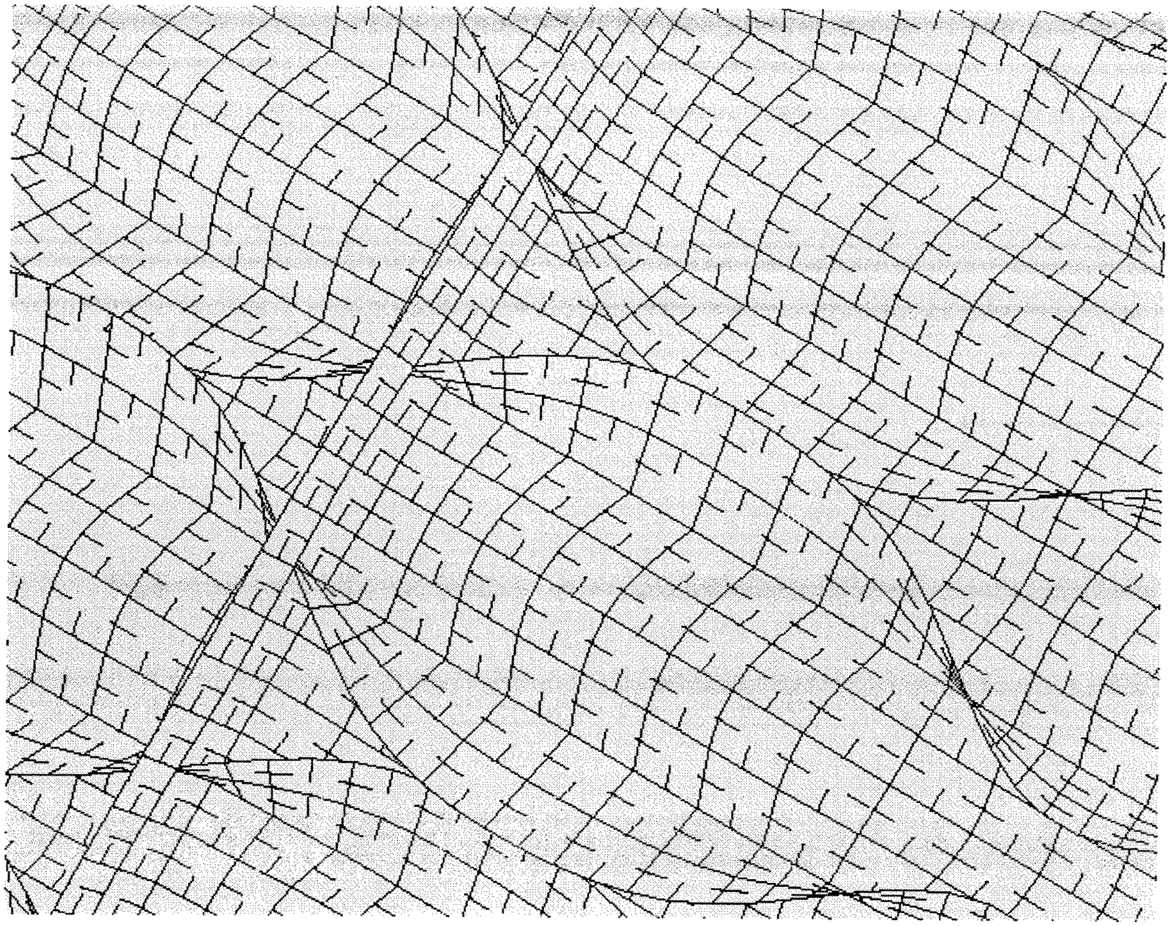


Fig. 80



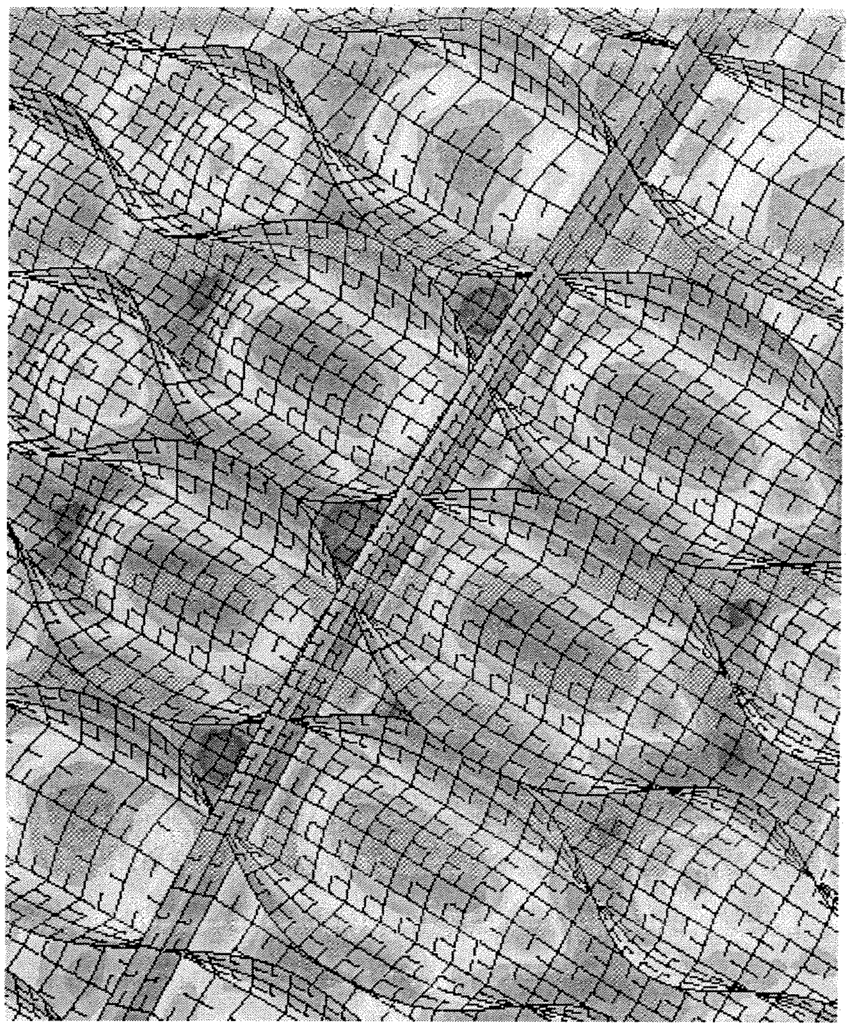
Same nonlinear equilibrium state as is shown in the previous figure

Fig. 81



Same nonlinear equilibrium state as is shown in the previous figure

Fig. 82



inner fiber effective stress
at PA=1,275

Fig. 83