Table 78 Optimum design of the **unstiffened imperfect equivalent ellipsoidal shell with the thick apex** (Shell Segment 1) of uniform thickness 0.4 inch. The optimum design and margins were obtained with the use of plus and minus axisymmetric modes 1 and 2 with amplitude, **Wimp=0.2 inch** and with the **lower bound of the uniform thickness of Shell Segment 1 (the spherical cap – see Fig. 2) set equal to 0.4 inch.** Two executions of SUPEROPT were used to obtain the optimum design (Figs. 143 and 144). This output is an abridged and edited version of the output file from GENOPT called "eqellipse.OPM", where "eqellipse" is the user-selected name of the specific case. Critical margins are in bold face. **Note that there is still a local thickened band, THKSKN(3), a characteristic present in the case of the optimum design for the unstiffened imperfect shell listed in Table 33, which was found to be under-designed.**

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  STRUCTURAL ANALYSIS WITH UNPERTURBED DECISION VARIABLES
 VAR.  CURRENT          DEFINITION
  NO.    VALUE
   1  4.0000E-01  skin thickness at xinput: THKSKN(1 )
   2  4.0000E-01  skin thickness at xinput: THKSKN(2 )
   3  6.0418E-01  skin thickness at xinput: THKSKN(3 )  ←thick band
   4  3.1405E-01  skin thickness at xinput: THKSKN(4 )
   5  3.6261E-01  skin thickness at xinput: THKSKN(5 )
   6  3.6471E-01  skin thickness at xinput: THKSKN(6 )
   7  3.0622E-01  skin thickness at xinput: THKSKN(7 )
   8  3.1319E-01  skin thickness at xinput: THKSKN(8 )
   9  2.8240E-01  skin thickness at xinput: THKSKN(9 )
  10  2.4984E-01  skin thickness at xinput: THKSKN(10)
  11  2.0428E-01  skin thickness at xinput: THKSKN(11)
  12  1.7857E-01  skin thickness at xinput: THKSKN(12)
  13  2.4628E-01  skin thickness at xinput: THKSKN(13)

  14  1.0000E-06  height of isogrid members at xinput: HIGHST(1 )
  15  1.0000E-06  height of isogrid members at xinput: HIGHST(2 )
  16  1.0000E-06  height of isogrid members at xinput: HIGHST(3 )
  17  1.0000E-06  height of isogrid members at xinput: HIGHST(4 )
  18  1.0000E-06  height of isogrid members at xinput: HIGHST(5 )
  19  1.0000E-06  height of isogrid members at xinput: HIGHST(6 )
  20  1.0000E-06  height of isogrid members at xinput: HIGHST(7 )
  21  1.0000E-06  height of isogrid members at xinput: HIGHST(8 )
  22  1.0000E-06  height of isogrid members at xinput: HIGHST(9 )
  23  1.0000E-06  height of isogrid members at xinput: HIGHST(10)
  24  1.0000E-06  height of isogrid members at xinput: HIGHST(11)
  25  1.0000E-06  height of isogrid members at xinput: HIGHST(12)
  26  1.0000E-06  height of isogrid members at xinput: HIGHST(13)

  27  3.0000E+00  spacing of the isogrid members: SPACNG
  28  1.0000E-05  thickness of an isogrid stiffening member: THSTIF
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******************** DESIGN OBJECTIVE ********************
   CURRENT VALUE OF THE OBJECTIVE FUNCTION:
VAR.   CURRENT
NO.      VALUE            DEFINITION
 1    1.271E+02  weight of the equivalent ellipsoidal head: WEIGHT
                   (Compare with WEIGHT = 96.46 lb in Table 33)

***** RESULTS FOR LOAD SET NO.  1  (+mode 1 and +mode 2) ******
MARGINS CORRESPONDING TO CURRENT DESIGN (F.S.= FACTOR OF SAFETY)
MARGIN CURRENT
NO.      VALUE            DEFINITION
 1   -9.745E-03 (CLAPS1(1 )/CLAPS1A(1 )) / CLAPS1F(1 )-1; F.S.=1.00
 2    3.842E-02 (GENBK1(1 )/GENBK1A(1 )) / GENBK1F(1 )-1; F.S.=1.00
 3    3.732E+01 (SKNBK1(1,1)/SKNBK1A(1,1))/SKNBK1F(1,1)-1;F.S.=1.00
 4    2.177E+01 (SKNBK1(1,2)/SKNBK1A(1,2))/SKNBK1F(1,2)-1;F.S.=1.00
 5    1.578E+04 (STFBK1(1,1)/STFBK1A(1,1))/STFBK1F(1,1)-1;F.S.=1.00
 6    1.301E+04 (STFBK1(1,2)/STFBK1A(1,2))/STFBK1F(1,2)-1;F.S.=1.00
 7   -1.557E-02 (SKNST1A(1,1)/SKNST1(1,1))/SKNST1F(1,1)-1;F.S.=1.00
 8    1.174E-02 (SKNST1A(1,2)/SKNST1(1,2))/SKNST1F(1,2)-1;F.S.=1.00
 9    4.852E-01 (STFST1A(1,1)/STFST1(1,1))/STFST1F(1,1)-1;F.S.=1.00
10    2.244E-01 (STFST1A(1,2)/STFST1(1,2))/STFST1F(1,2)-1;F.S.=1.00
11    1.776E+00 (WAPEX1A(1 )/WAPEX1(1 )) / WAPEX1F(1 )-1; F.S.=1.00

12    3.022E-01 (CLAPS2(1 )/CLAPS2A(1 )) / CLAPS2F(1 )-1; F.S.=1.00
13    3.709E-01 (GENBK2(1 )/GENBK2A(1 )) / GENBK2F(1 )-1; F.S.=1.00
14    4.477E+01 (SKNBK2(1,1)/SKNBK2A(1,1))/SKNBK2F(1,1)-1;F.S.=1.00
15    2.120E+01 (SKNBK2(1,2)/SKNBK2A(1,2))/SKNBK2F(1,2)-1;F.S.=1.00
16    2.908E+04 (STFBK2(1,1)/STFBK2A(1,1))/STFBK2F(1,1)-1;F.S.=1.00
17    1.379E+04 (STFBK2(1,2)/STFBK2A(1,2))/STFBK2F(1,2)-1;F.S.=1.00
18    5.317E-01 (SKNST2A(1,1)/SKNST2(1,1))/SKNST2F(1,1)-1;F.S.=1.00
19   -4.177E-02 (SKNST2A(1,2)/SKNST2(1,2))/SKNST2F(1,2)-1;F.S.=1.00
20    1.738E+00 (STFST2A(1,1)/STFST2(1,1))/STFST2F(1,1)-1;F.S.=1.00
21    2.986E-01 (STFST2A(1,2)/STFST2(1,2))/STFST2F(1,2)-1;F.S.=1.00
22    2.885E+00 (WAPEX2A(1 )/WAPEX2(1 )) / WAPEX2F(1 )-1; F.S.=1.00


***** RESULTS FOR LOAD SET NO.  2  (-mode 1 and -mode 2) ******
MARGINS CORRESPONDING TO CURRENT DESIGN (F.S.= FACTOR OF SAFETY)
MARGIN CURRENT
NO.      VALUE            DEFINITION
 1    5.382E-02 (CLAPS1(2 )/CLAPS1A(2 )) / CLAPS1F(2 )-1; F.S.=1.00
 2    5.146E-01 (GENBK1(2 )/GENBK1A(2 )) / GENBK1F(2 )-1; F.S.=1.00
 3    6.134E+01 (SKNBK1(2,1)/SKNBK1A(2,1))/SKNBK1F(2,1)-1;F.S.=1.00
 4    2.138E+01 (SKNBK1(2,2)/SKNBK1A(2,2))/SKNBK1F(2,2)-1;F.S.=1.00
 5    1.512E+04 (STFBK1(2,1)/STFBK1A(2,1))/STFBK1F(2,1)-1;F.S.=1.00
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  6    1.394E+04 (STFBK1(2,2)/STFBK1A(2,2))/STFBK1F(2,2)-1;F.S.=1.00
 7   -1.111E-03 (SKNST1A(2,1)/SKNST1(2,1))/SKNST1F(2,1)-1;F.S.=1.00
 8   -1.169E-02 (SKNST1A(2,2)/SKNST1(2,2))/SKNST1F(2,2)-1;F.S.=1.00
  9    4.231E-01 (STFST1A(2,1)/STFST1(2,1))/STFST1F(2,1)-1;F.S.=1.00
 10    3.122E-01 (STFST1A(2,2)/STFST1(2,2))/STFST1F(2,2)-1;F.S.=1.00
 11    2.746E-01 (WAPEX1A(2 )/WAPEX1(2 )) / WAPEX1F(2 )-1; F.S.=1.00

 12   -3.818E-02 (CLAPS2(2 )/CLAPS2A(2 )) / CLAPS2F(2 )-1; F.S.=1.00
 13    3.875E-01 (GENBK2(2 )/GENBK2A(2 )) / GENBK2F(2 )-1; F.S.=1.00
 14    5.811E+01 (SKNBK2(2,1)/SKNBK2A(2,1))/SKNBK2F(2,1)-1;F.S.=1.00
 15    2.189E+01 (SKNBK2(2,2)/SKNBK2A(2,2))/SKNBK2F(2,2)-1;F.S.=1.00
 16    2.123E+04 (STFBK2(2,1)/STFBK2A(2,1))/STFBK2F(2,1)-1;F.S.=1.00
 17    1.455E+04 (STFBK2(2,2)/STFBK2A(2,2))/STFBK2F(2,2)-1;F.S.=1.00
 18    1.794E-02 (SKNST2A(2,1)/SKNST2(2,1))/SKNST2F(2,1)-1;F.S.=1.00
 19    1.078E-01 (SKNST2A(2,2)/SKNST2(2,2))/SKNST2F(2,2)-1;F.S.=1.00
 20    9.987E-01 (STFST2A(2,1)/STFST2(2,1))/STFST2F(2,1)-1;F.S.=1.00
 21    3.699E-01 (STFST2A(2,2)/STFST2(2,2))/STFST2F(2,2)-1;F.S.=1.00
 22    4.534E-01 (WAPEX2A(2 )/WAPEX2(2 )) / WAPEX2F(2 )-1; F.S.=1.00
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NOTE:  The design margins listed above are divided into two groups of
11 margins each: Margins 1 — 11 and Margins 12 — 22. The first group
of 11 margins are obtained with use of the axisymmetric mode 1
imperfection, and the second group of 11 margins are obtained with
use of the axisymmetric mode 2 imperfection.
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