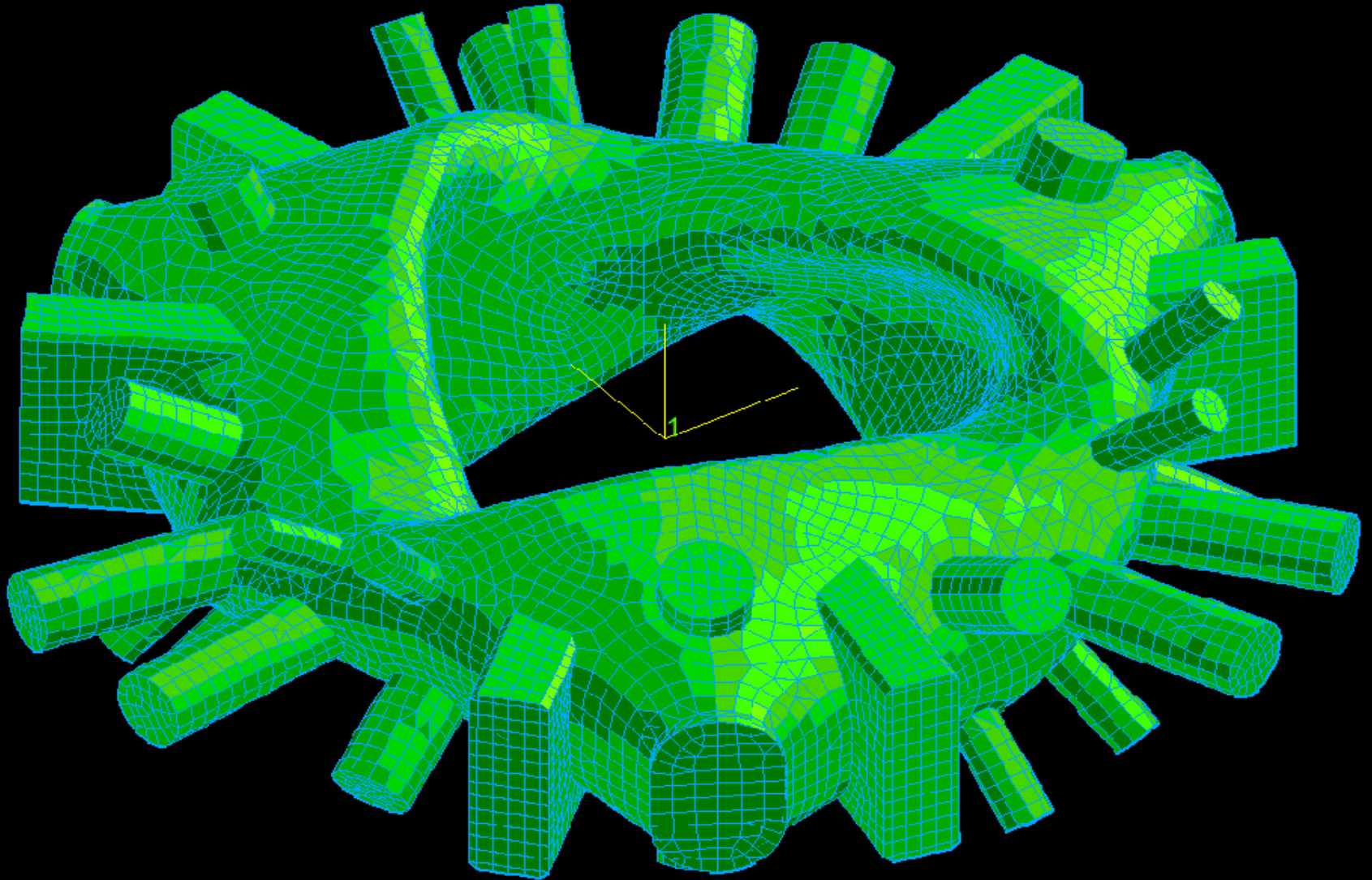


NCSX-Vessel Buckling

LI386-1 atmosphere, free radial b.c.

Fred Dahlgren - 26 April 2001

NCSX Vacuum Vessel - Nastran Shell Element Model



FEA Model Details:

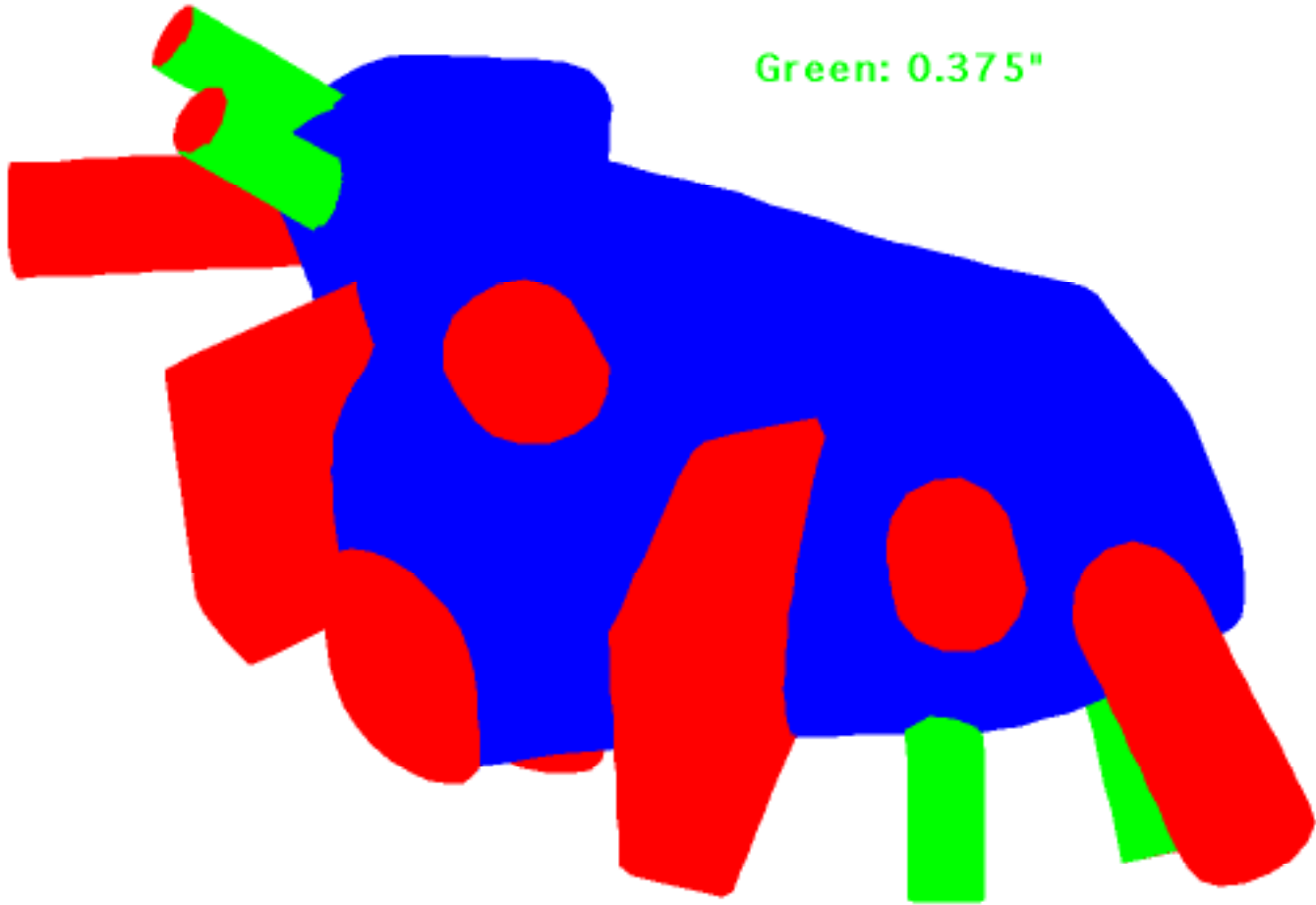
- | | | |
|--------------|---|--------------|
| 1. Elements: | CQUAD4 | 9,876 |
| | CTRIA3 | <u>4,104</u> |
| | Total: | 13,980 |
| 2. Nodes: | GRIDS | 11,928 |
| | (DOF's) | 71,568 (-6) |
| 3. B.C.s: | Vertical & Circumferential SPCs
@ RF Launcher Port Centerline
(6 DOFs, constraining R.B. modes) | |
| 4. | Full 360 degrees model – Static pressure load | |
| 5. | Lanzcos Eigenvalue problem using differential
Stiffness derived from static analysis. | |

Model A Thicknesses

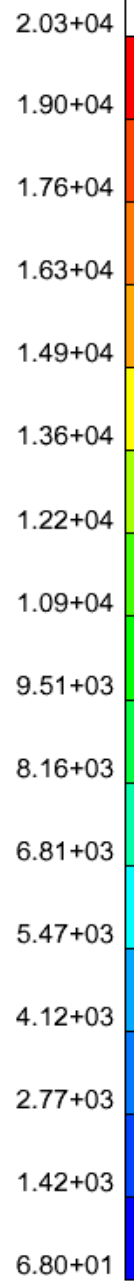
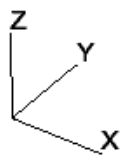
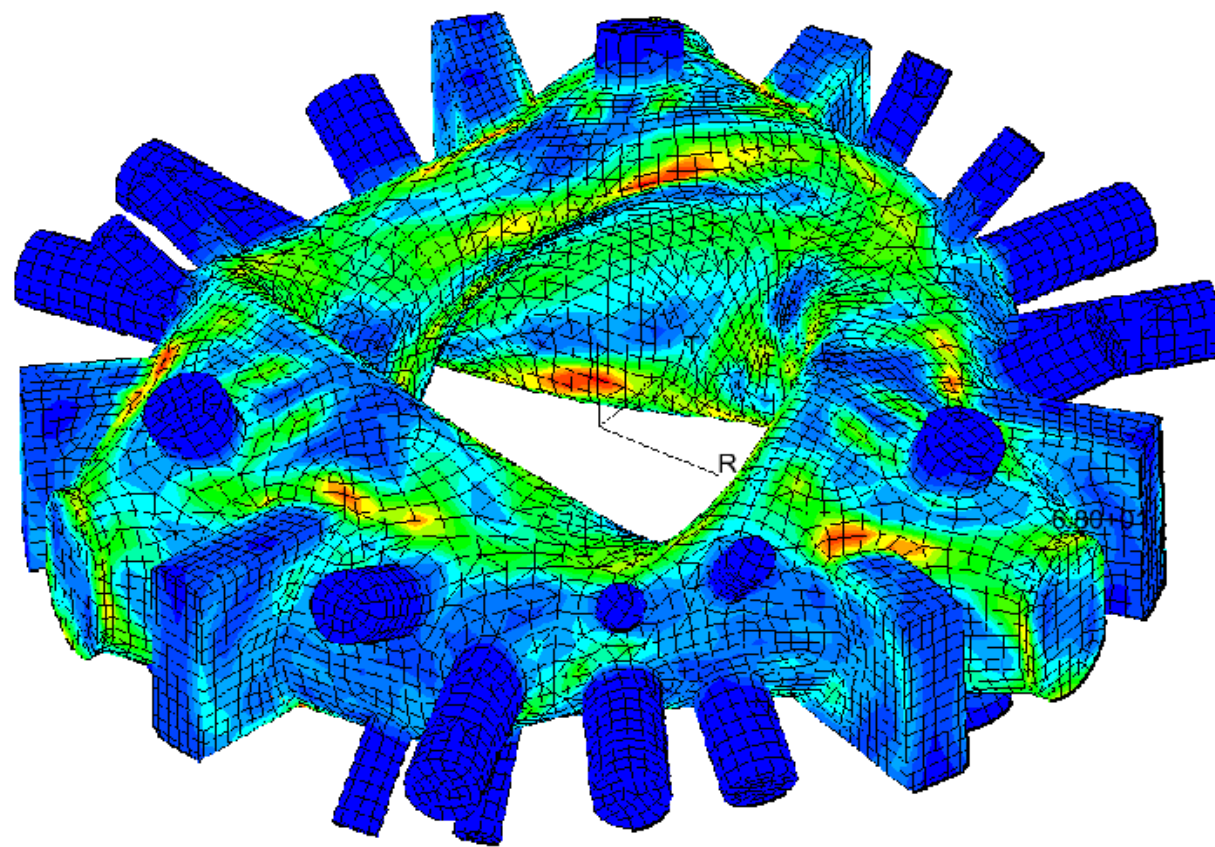
Red: 0.475"

Blue: 0.175"

Green: 0.375"

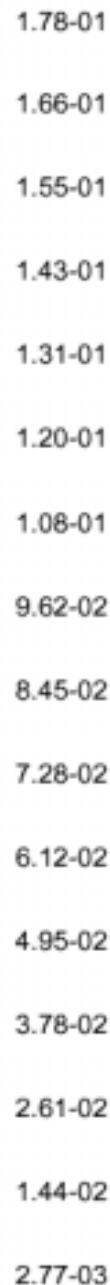
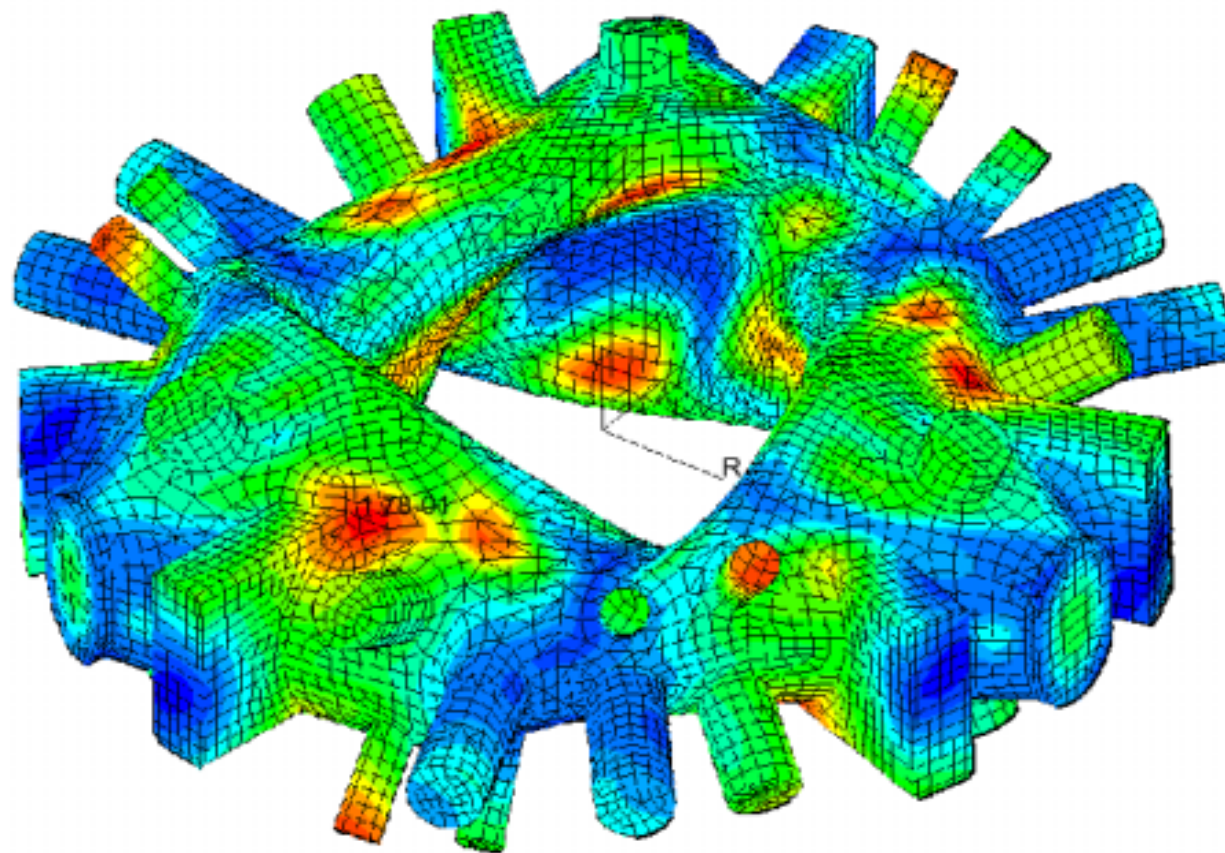


Shell Thickness = 0.175



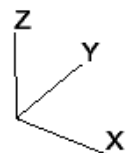
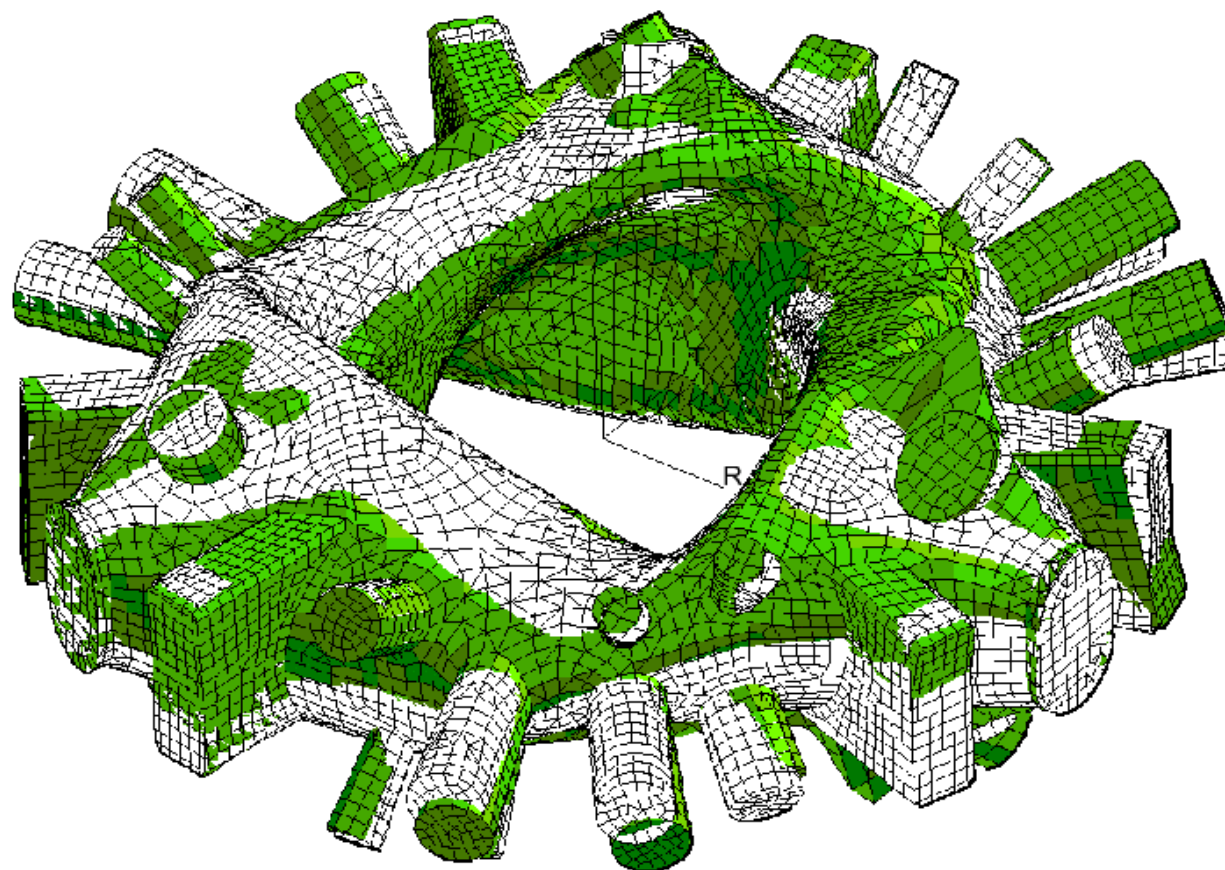
default_Fringe :
Max 2.03+04 @Nd 1329
Min 6.80+01 @Nd 577

Shell Thickness = 0.175



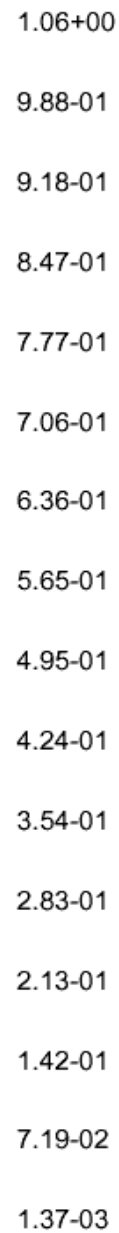
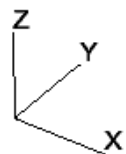
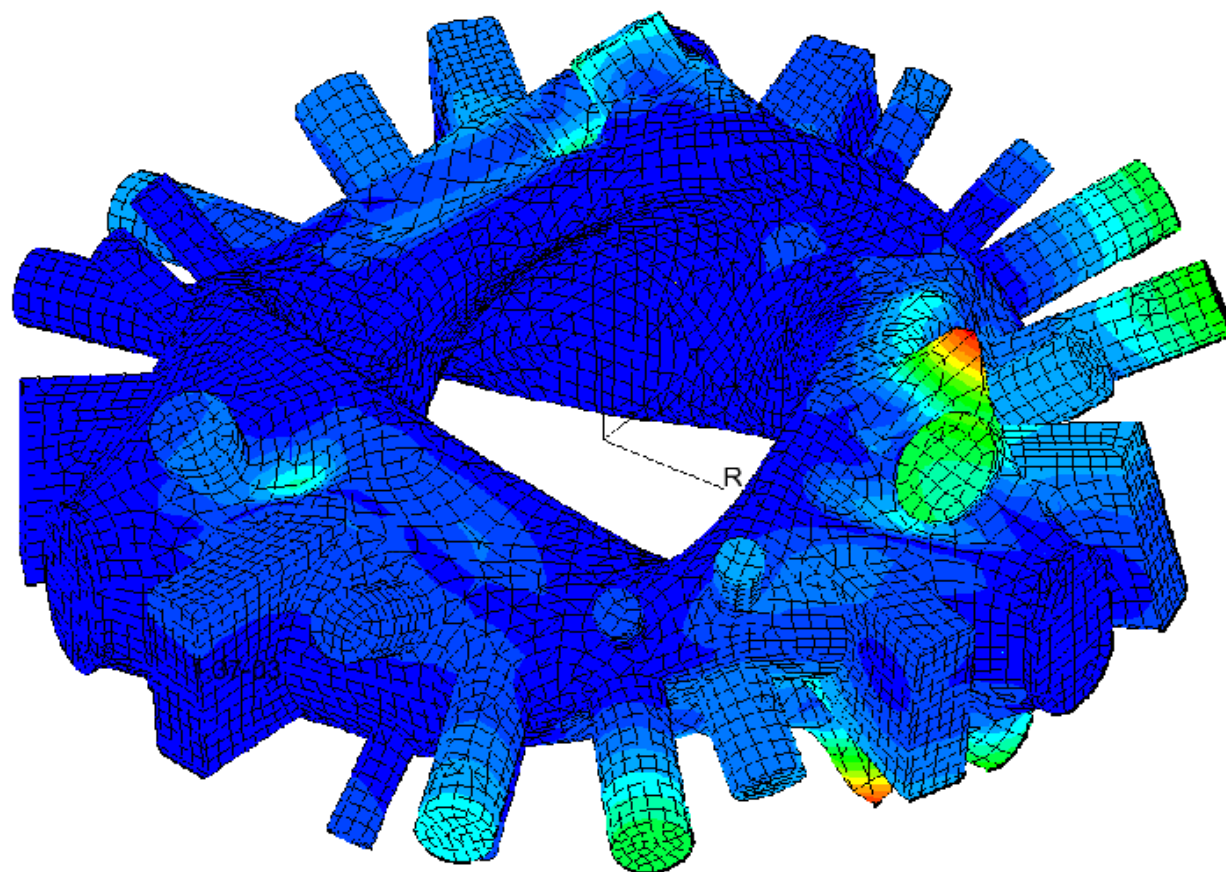
default_Fringe :
Max 1.78-01 @Nd 9514
Min 2.77-03 @Nd 6538

Shell Thickness = 0.175



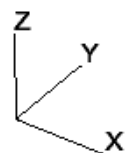
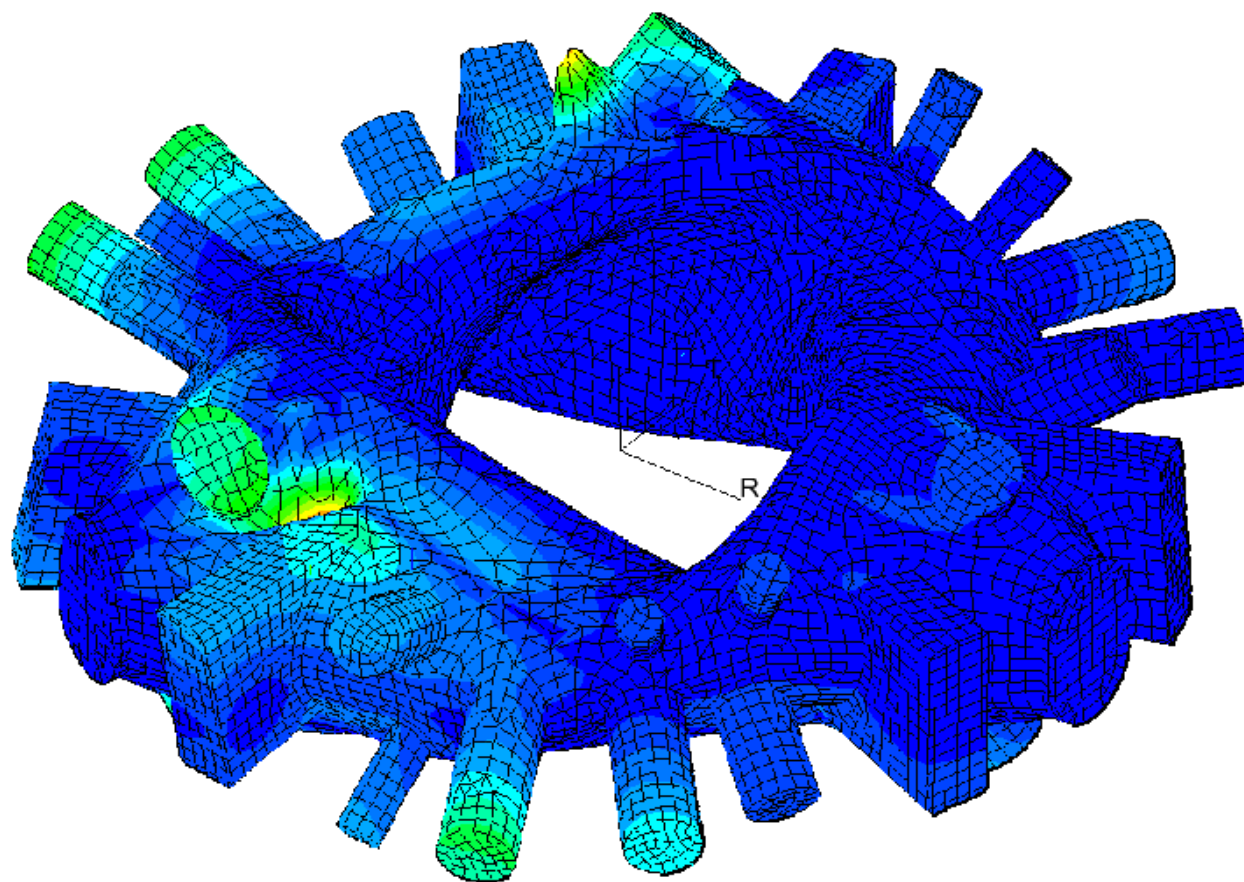
1st Buckling Mode

Shell Thickness = 0.175



default_Fringe :
Max 1.06+00 @Nd 1769
Min 1.37-03 @Nd 10143
default_Deformation :
Max 1.06+00 @Nd 1769

Shell Thickness = 0.175

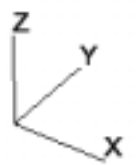
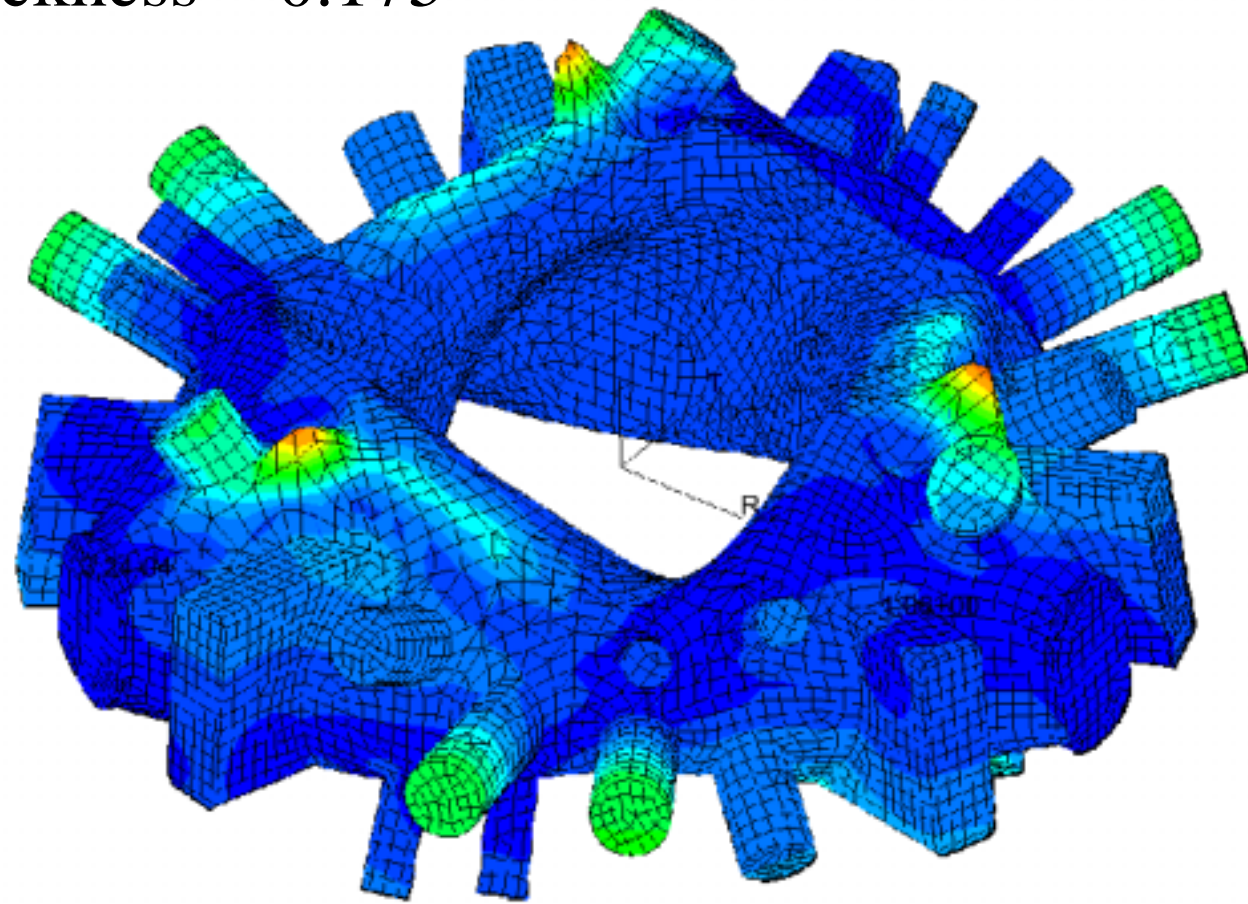


1.06+00
9.89-01
9.19-01
8.48-01
7.78-01
7.07-01
6.36-01
5.66-01
4.95-01
4.25-01
3.54-01
2.84-01
2.13-01
1.42-01
7.19-02
1.33-03

default_Fringe :
Max 1.06+00 @Nd 11727
Min 1.33-03 @Nd 1531
default_Deformation :
Max 1.06+00 @Nd 11727

Fringe: 1 ATMOSPHERE (LI386 MODEL), Mode 3 : Factor=2.9624: Eigenvectors, Translational-(NON-LAYERED) (MAG)
Deform: 1 ATMOSPHERE (LI386 MODEL), Mode 3 : Factor=2.9624: Eigenvectors, Translational

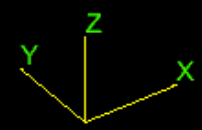
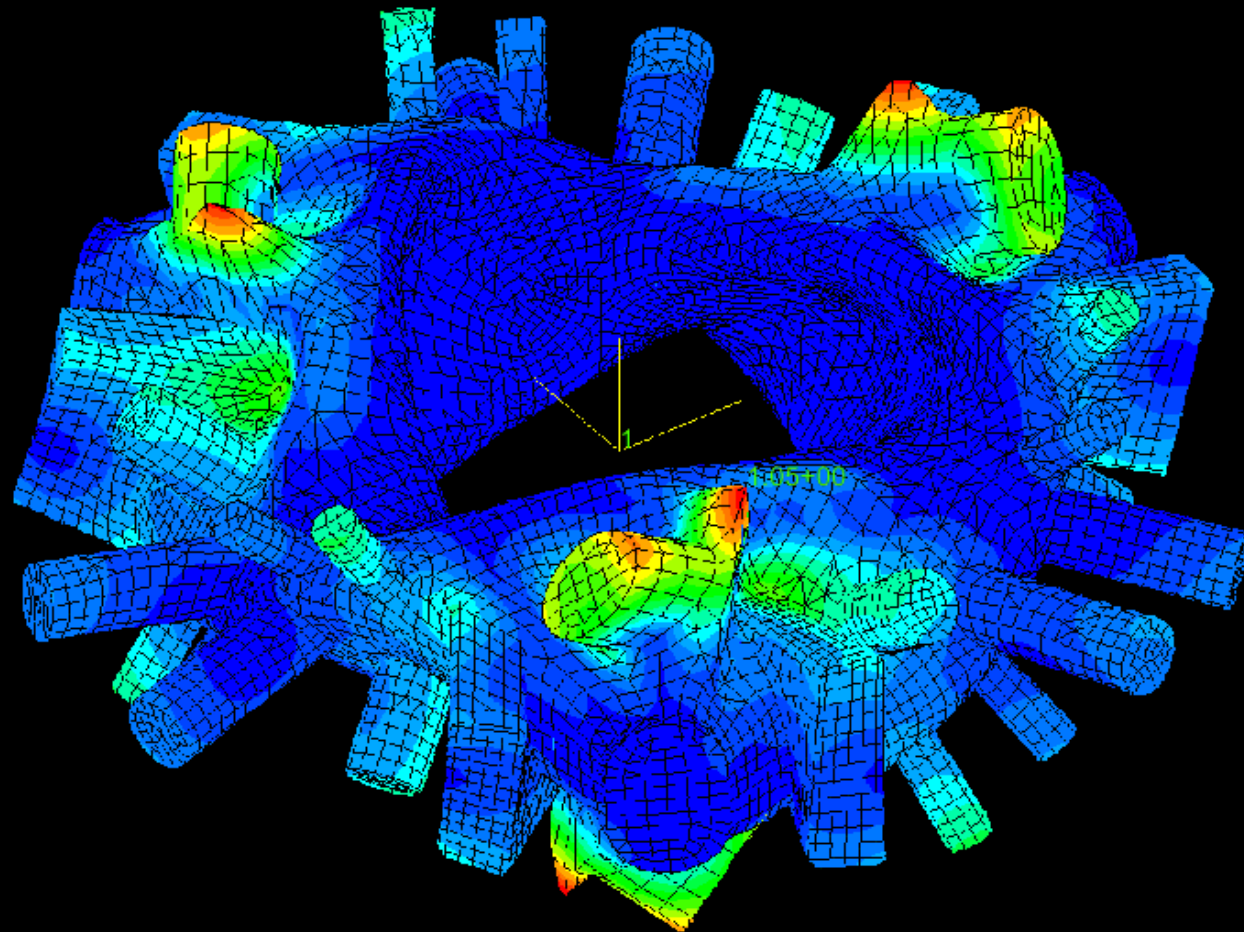
Shell Thickness = 0.175



default_Fringe :
Max 1.06+00 @Nd 3814
Min 3.24-04 @Nd 11983
default_Deformation :
Max 1.06+00 @Nd 3814

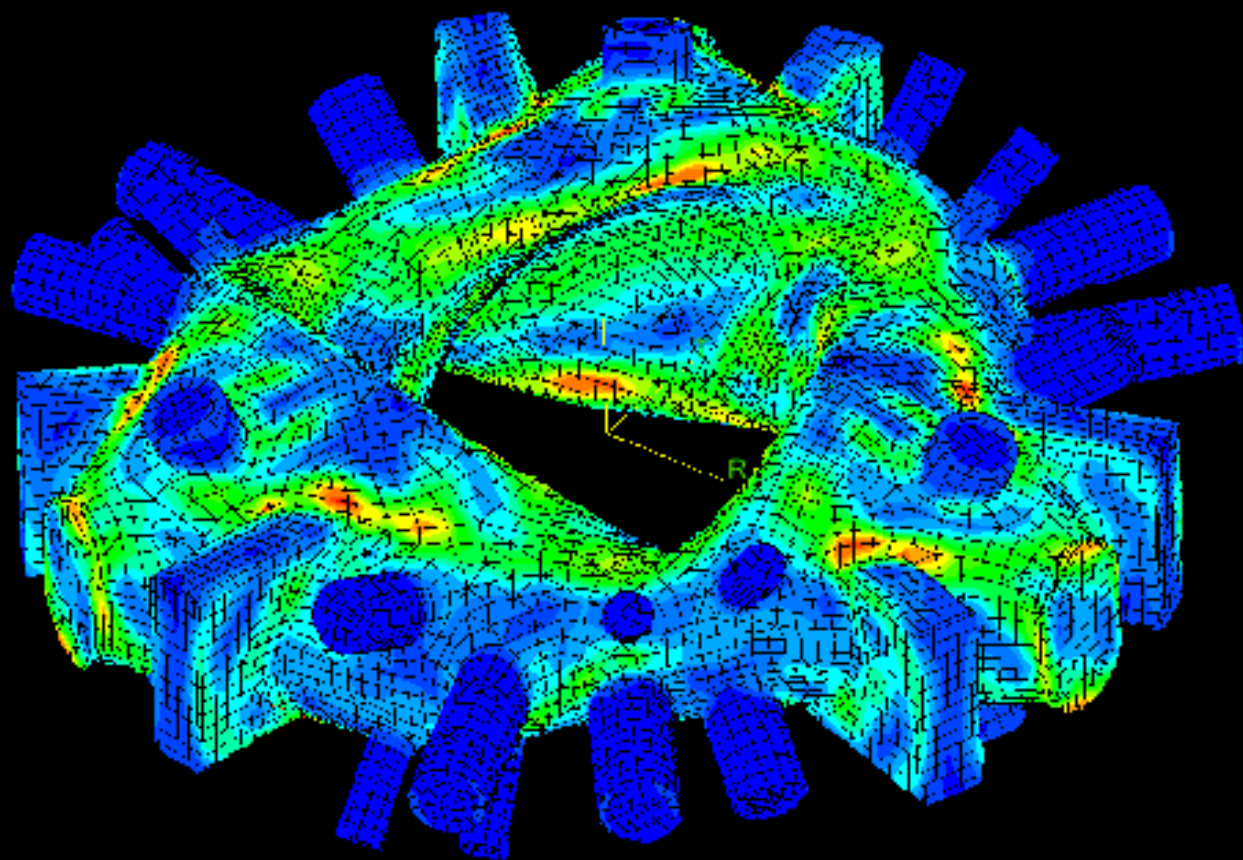
QuickTime™ and a
Graphics decompressor
are needed to see this picture.

Shell Thickness = 0.250



default_Fringe :
Max 1.05+00 @Nd 9776
Min 3.57-03 @Nd 7467
default_Deformation :
Max 1.05+00 @Nd 9776

Shell Thickness = 0.250



1.34+04

1.25+04

1.16+04

1.08+04

9.86+03

8.97+03

8.08+03

7.19+03

6.30+03

5.41+03

4.52+03

3.63+03

2.74+03

1.85+03

9.62+02

7.19+01

default_Fringe :
Max 1.34+04 @Nd 7850
Min 7.19+01 @Nd 12364

QuickTime™ and a
Video decompressor
are needed to see this picture.

Conclusions:

- Stresses are generally at or below allowables (ASME-Grade1 annealed Inconel-625: 27.5ksi, ASTM-B-443).
- Local buckling at RF Launcher port nozzle to shell transition $\lambda = 2.9$ for 0.175" thk. Shell
- $\lambda = 6.7$ for 0.250" thick Shell
- May need to increase shell thickness to a 0.220" minimum thickness to meet code S.F. of 5x