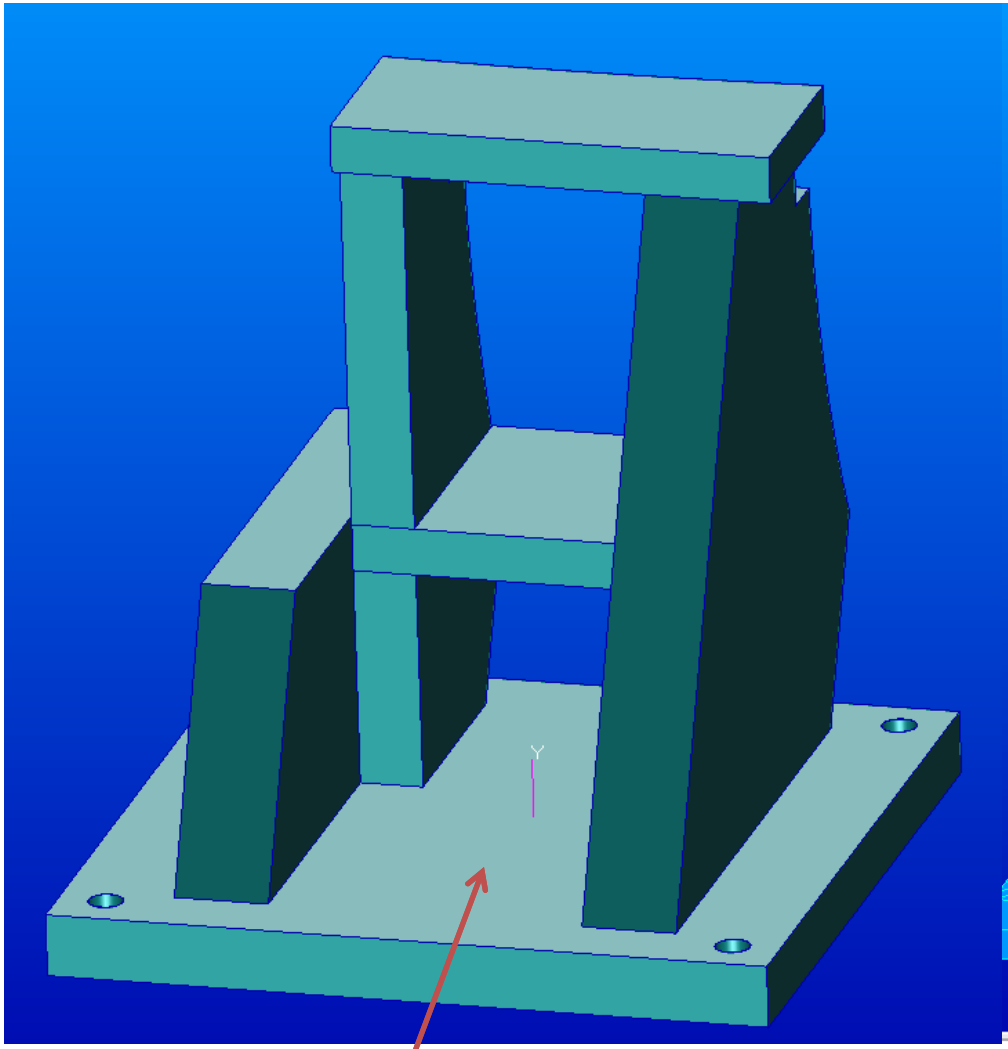
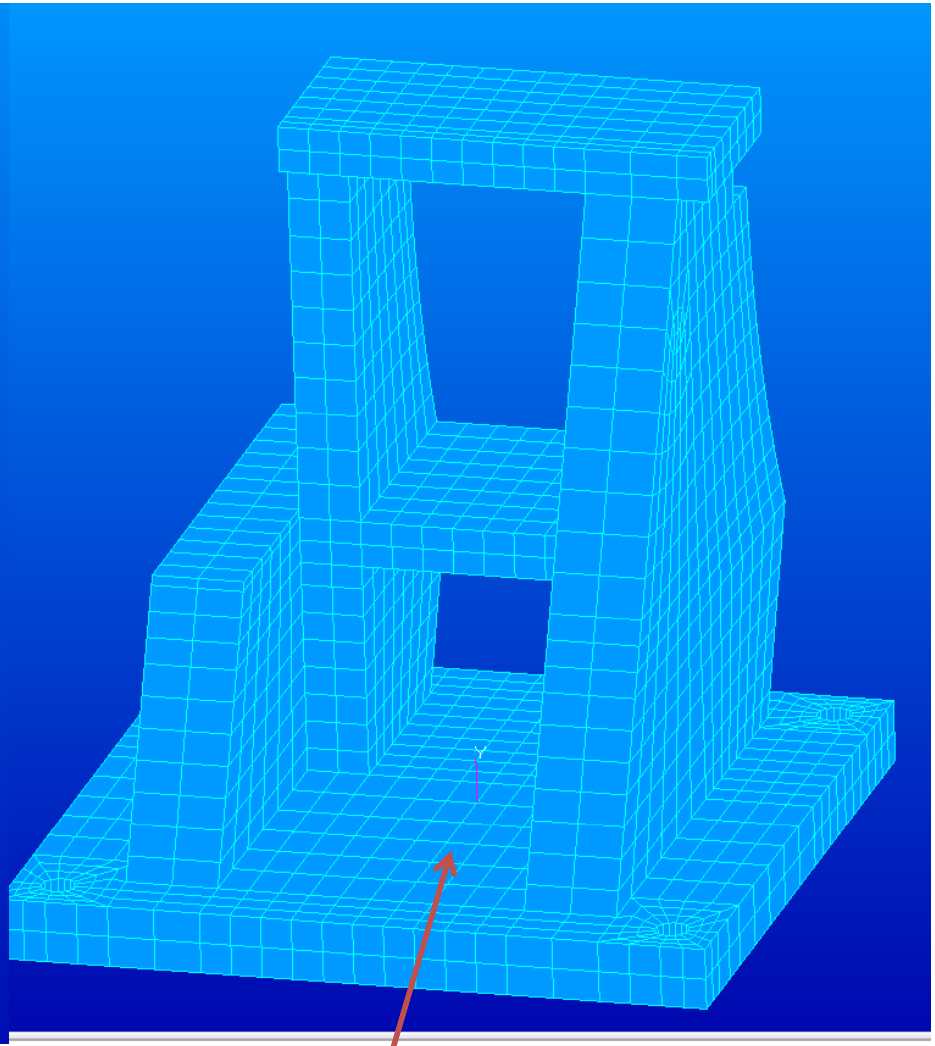
NSTXU PROJECT

Vessel-Support-Chair.ppt

Complete simulation justification

P.R. March 2012



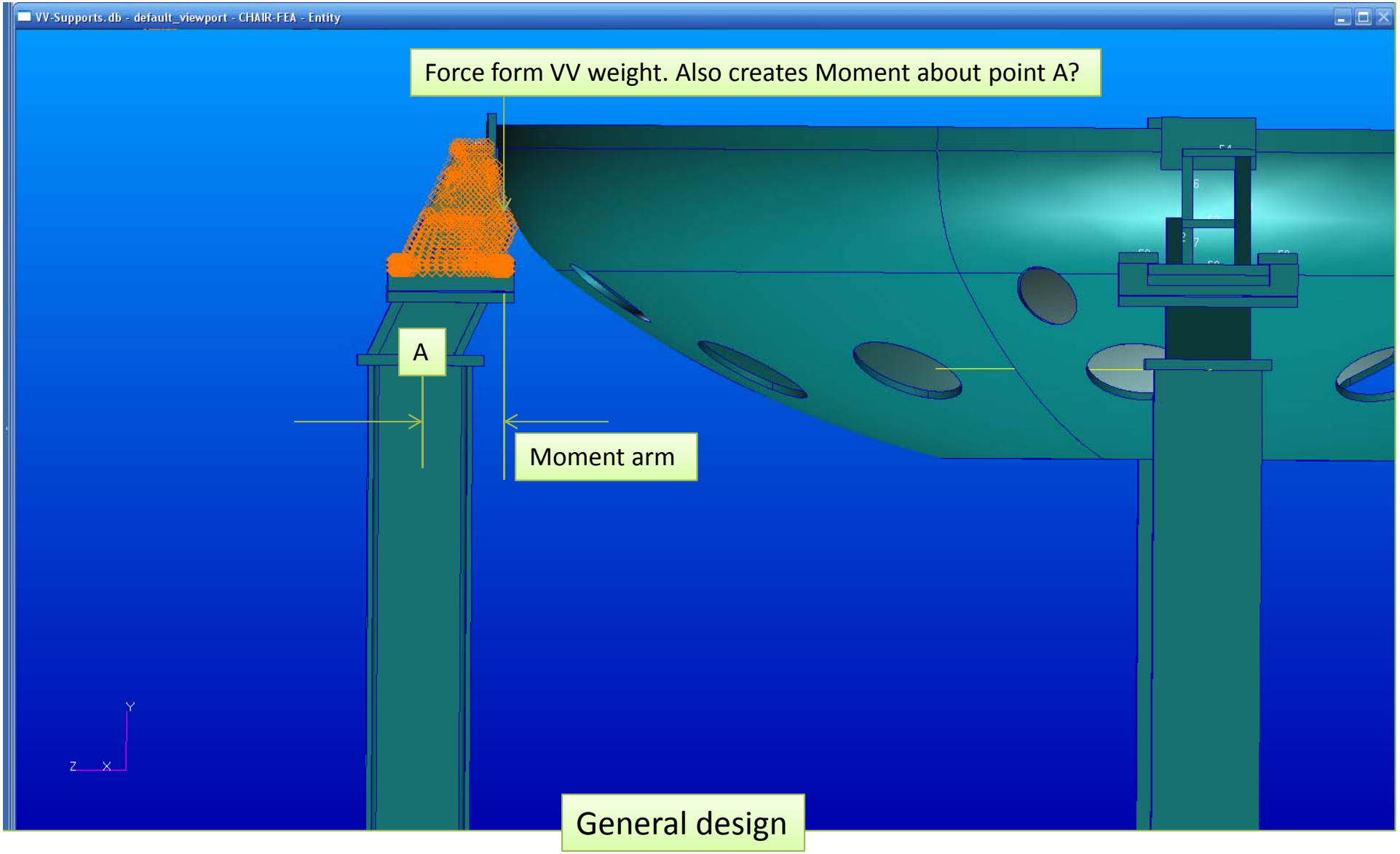


VV-support-attach-011812.igs

Nastran FEA all Hex8 elements

Question: How is this welded, assume weld size = 3/8 inch?

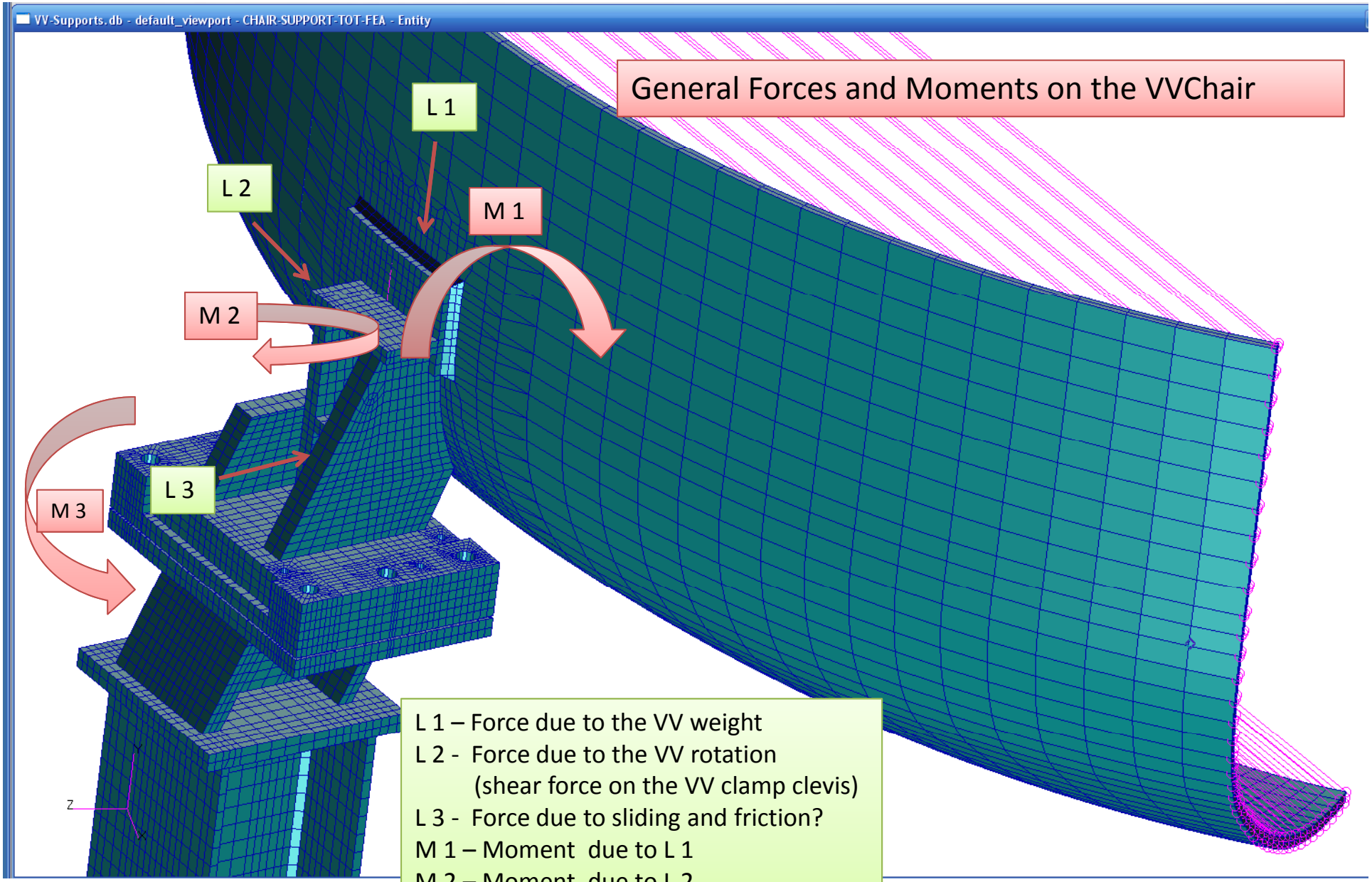
Redesigned VV support chair



General design

VV – Chair support configuration
[Complete geometry provided by M. Smith, 1/2012]

General Forces and Moments on the VVChair



L 1 – Force due to the VV weight
L 2 - Force due to the VV rotation
(shear force on the VV clamp clevis)
L 3 - Force due to sliding and friction?
M 1 – Moment due to L 1
M 2 – Moment due to L 2
M 3 – Moment due to L 3

Note: Force L 3 is a function of "L 1" and the coefficient of friction at the slide plate/cradle interface

Complete model input file set-up

Note RUN #5 chosen for the demonstration (other runs are similar).

```
$ NASTRAN input file created by the MSC FEA 2010.1.2 64-Bit input file
$ translator on March     08, 2012 at 12:06:33.
$ Nonlinear Static Analysis, Database
SOL 106
CEND
TITLE = MSC.NASTRAN JOB CREATED ON 17-FEB-12 AT 08:48:38
ECHO = NONE
MPC = 20134
SUBCASE 1
   TITLE=Non-Linear
   SUBTITLE=RUN5-Loads
   NLPARM = 1
   SPC = 2
   LOAD = 2
   DISPLACEMENT(SORT1,REAL)=ALL
   SPCFORCES(SORT1,REAL)=ALL
   STRAIN(SORT1,REAL,VONMISES,STRCUR,BILIN)=ALL
   STRESS(SORT1,REAL,VONMISES,BILIN)=ALL
$ Direct Text Input for this Subcase
BEGIN BULK
$ Direct Text Input for Bulk Data
PARAM     POST    0
PARAM     AUTOSPC YES
PARAM    PRTMAXIM YES
NLPARM    1       10              AUTO     5        25       P        NO
                 .01
```

General Executive deck

```
$ Elements and Element Properties for region : Sliding-Gaps
PGAP      2       0.              3.+7     500.     1.+7     .3       .3
         -1.
$ Pset: "Sliding-Gaps" will be imported as: "pgap.2"
CGAP      94612   2       102192  127702                             2
CGAP      94613   2       102195  128013                             2
```

GAPs definition

```
                          M O D E L   S U M M A R Y

     NUMBER OF GRID      POINTS    =    34815

     NUMBER OF CGAP      ELEMENTS  =      660
     NUMBER OF CHEXA     ELEMENTS  =    23184
     NUMBER OF CPENTA    ELEMENTS  =     1336
     NUMBER OF CTETRA    ELEMENTS  =       33

     NUMBER OF RBE2      ELEMENTS  =      977
17-FEB-12 AT 08:48:38                                MARCH    8, 2012
```

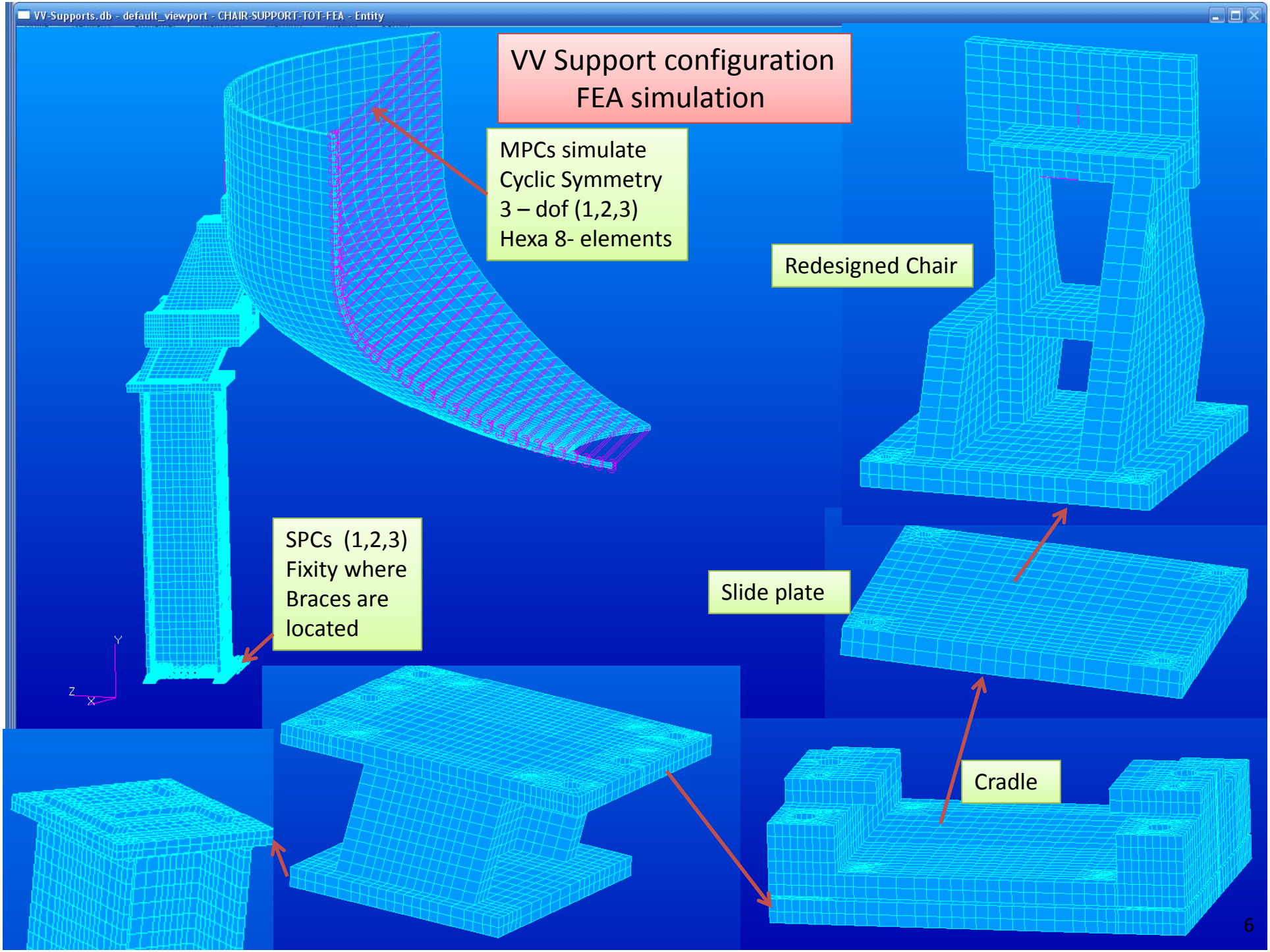
Total load due to the Pressure

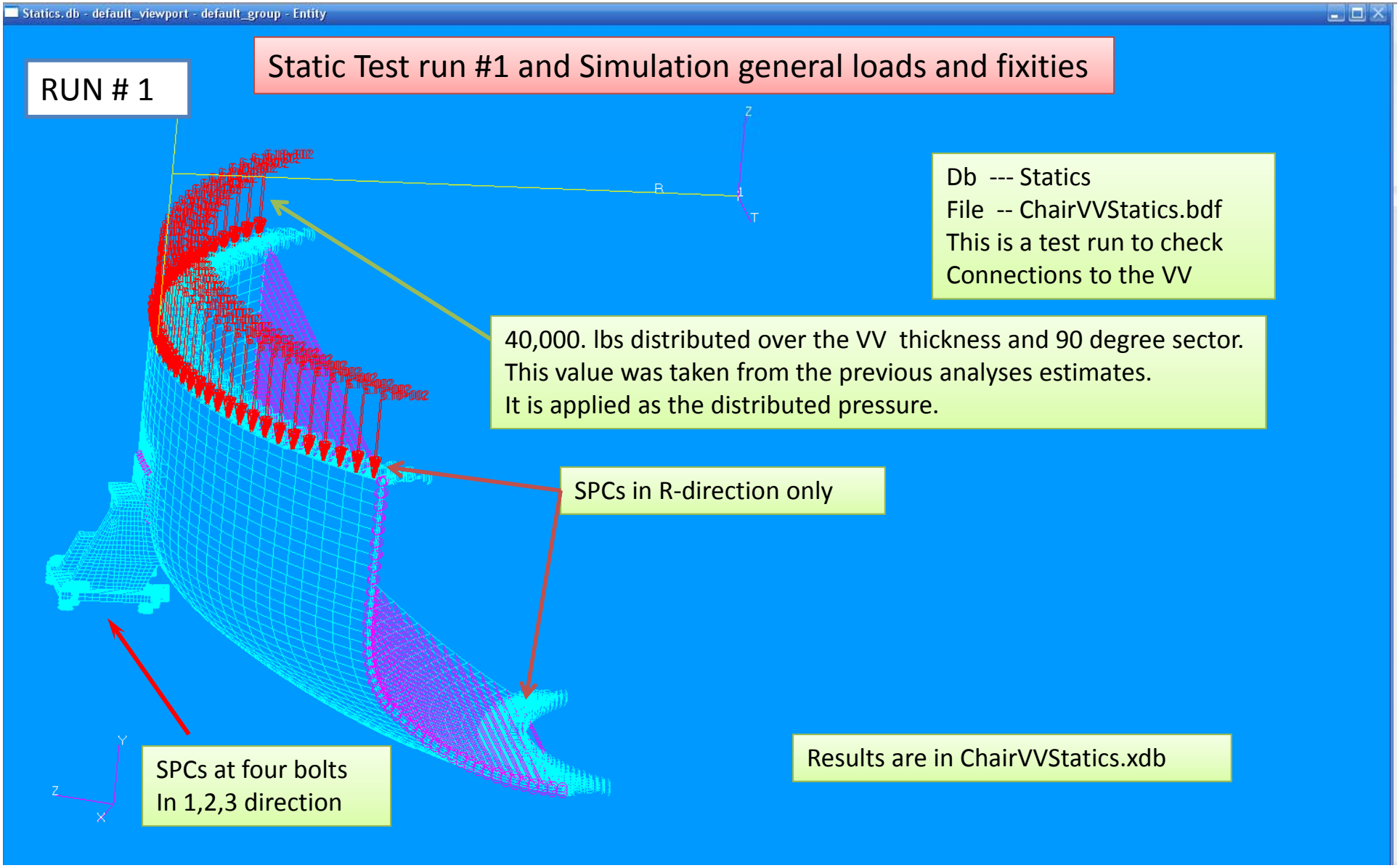
Simulation grid and element statistics

Clevis loads (only for run #5)

```
     RESULTANTS ABOUT ORIGIN OF SUPERELEMENT BASIC COORDINATE SYSTEM IN SUPERELEMENT BASIC SYSTEM COORDINATE
0                                                    OLOAD    RESULTANT
  SUBCASE/     LOAD
  DAREA ID     TYPE          T1             T2             T3             R1             R2             R3
0        1      FX    3.576299E+04      ----           ----           ----      2.319899E+06   1.403519E+06
                FY          ----     -3.998594E+04      ----      2.221206E+06      ----      -9.220052E+05
                FZ          ----           ----     -9.487278E+03  3.723282E+05  1.632618E+05      ----
                MX          ----           ----           ----      0.000000E+00      ----           ----
                MY          ----           ----           ----           ----      0.000000E+00      ----
                MZ          ----           ----           ----           ----           ----      0.000000E+00
              TOTALS  3.576299E+04 -3.998594E+04 -9.487278E+03  2.593534E+06  2.483160E+06  4.815134E+05
1    MSC.NASTRAN JOB CREATED ON 17-FEB-12 AT 08:48:38                              MARCH    8, 2012  MSC.NASTRAN
```

Resultant applied loads from the .f06 output

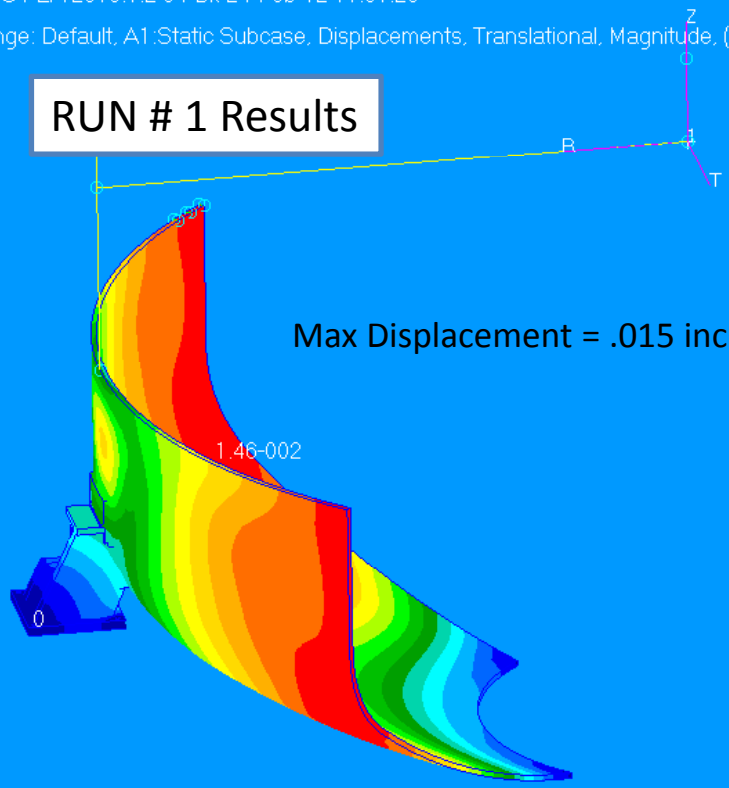

VV-Supports.db - default_viewport - CHAIR-SUPPORT-TOT-FEA - Entity
VV Support configuration
FEA simulation
MPCs simulate
Cyclic Symmetry
3 – dof (1,2,3)
Hexa 8- elements
Redesigned Chair
SPCs (1,2,3)
Fixity where
Braces are
located
Slide plate
Cradle


Statics.db - default_viewport - default_group - Entity
RUN # 1
Static Test run #1 and Simulation general loads and fixities
Db --- Statics
File -- ChairVVStatics.bdf
This is a test run to check
Connections to the VV
40,000. lbs distributed over the VV thickness and 90 degree sector.
This value was taken from the previous analyses estimates.
It is applied as the distributed pressure.
SPCs in R-direction only
SPCs at four bolts
In 1,2,3 direction
Results are in ChairVVStatics.xdb

MSC FEA 2010.1.2 64-Bit 24-Feb-12 11:37:20

Fringe: Default, A1:Static Subcase, Displacements, Translational, Magnitude, (NON-LAYERED)

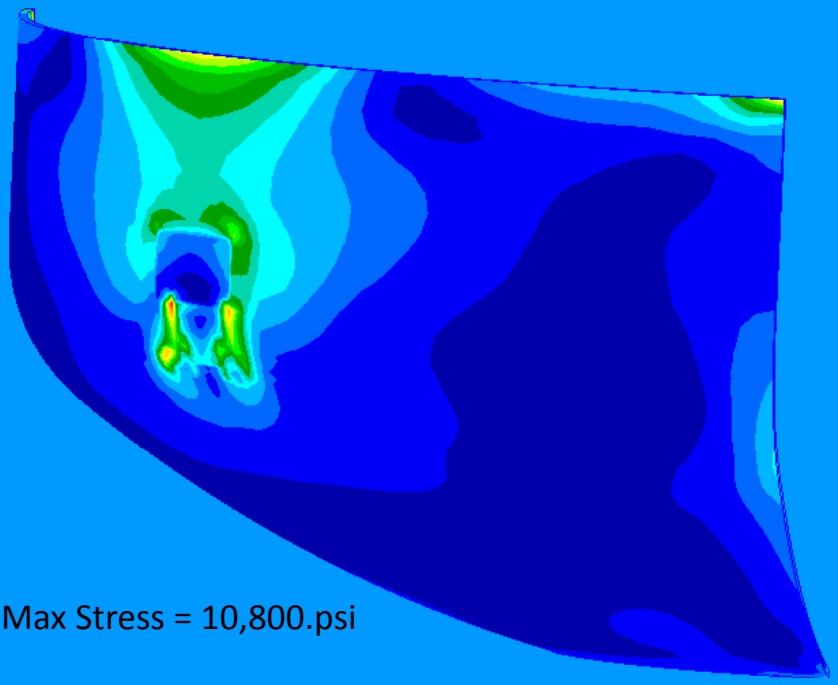
RUN # 1 Results



Max Displacement = .015 inch.

MSC FEA 2010.1.2 64-Bit 24-Feb-12 11:44:14

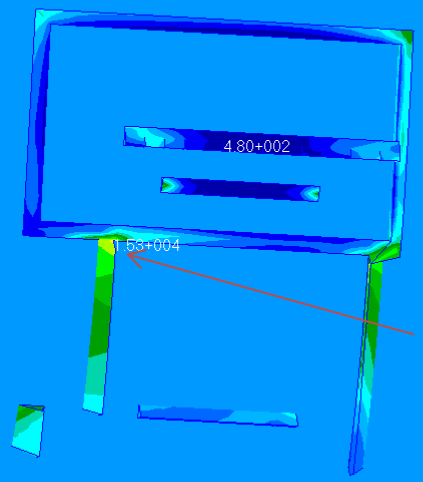
Fringe: Default, A1:Static Subcase, Stress Tensor, , von Mises, (NON-LAYERED)



Max Stress = 10,800.psi

MSC FEA 2010.1.2 64-Bit 24-Feb-12 11:47:06

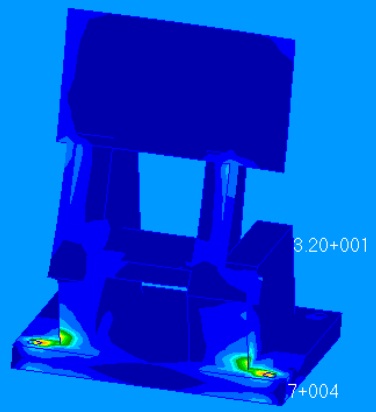
Fringe: Default, A1:Static Subcase, Stress Tensor, , von Mises, (NON-LAYERED)



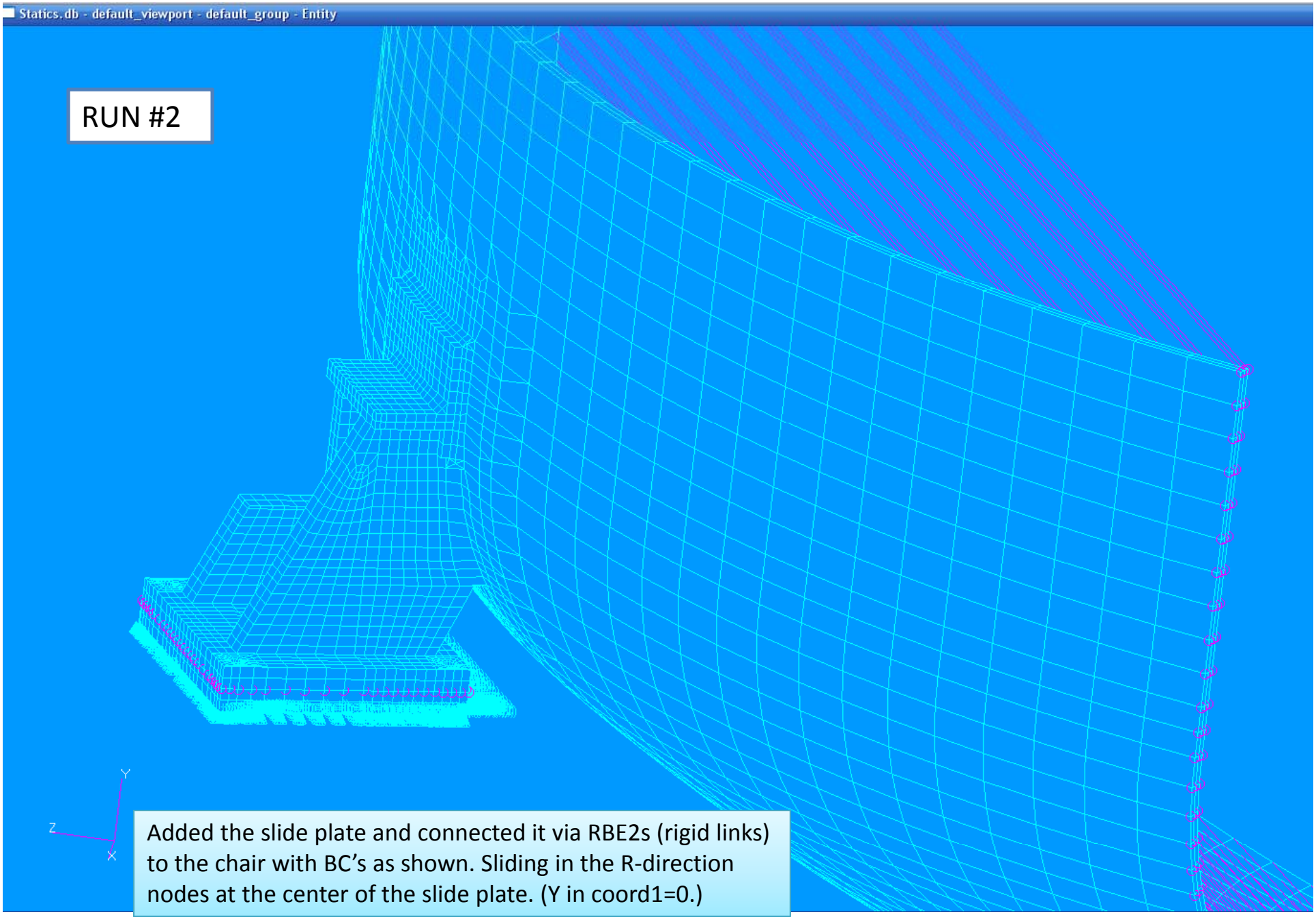
Max stress = 15,300.psi

MSC FEA 2010.1.2 64-Bit 24-Feb-12 11:52:31

Fringe: Default, A1:Static Subcase, Stress Tensor, , von Mises, (NON-LAYERED)



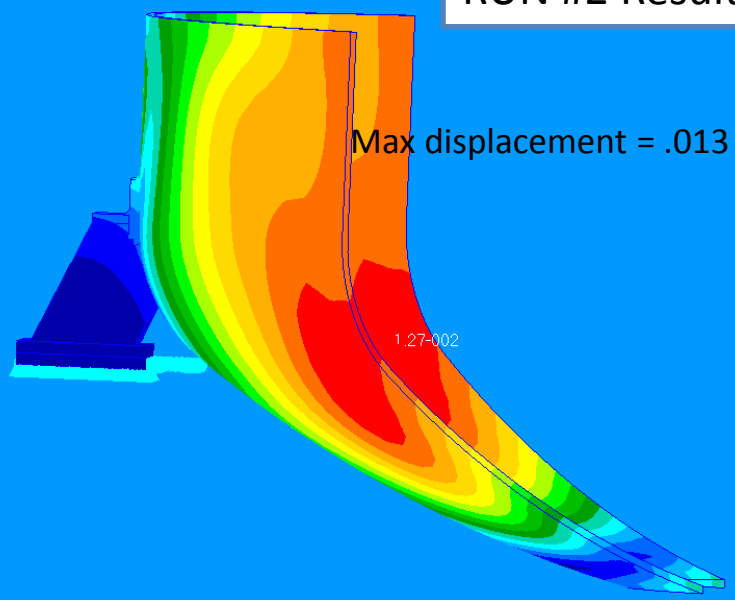
Max Stress = 56,700.psi
Note:(not real-concentrated load in bolt region)


Statics.db - default_viewport - default_group - Entity
RUN #2
Y
Z
X
Added the slide plate and connected it via RBE2s (rigid links) to the chair with BC's as shown. Sliding in the R-direction nodes at the center of the slide plate. (Y in coord1=0.)

MSC FEA 2010.1.2 64-Bit 28-Feb-12 13:46:02

Fringe: RUN2-Loads, A2:Static Subcase, Displacements, Translational, Magnitude, (NON-LAYERED)

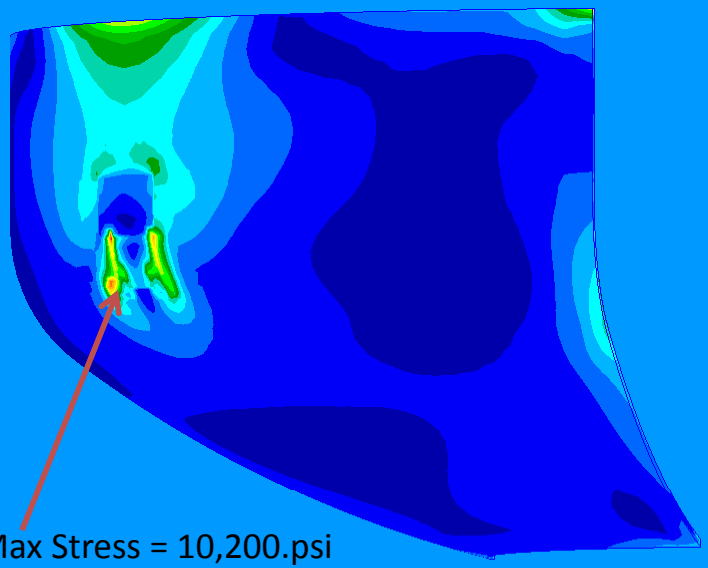
RUN #2 Results



Max displacement = .013 inch

MSC FEA 2010.1.2 64-Bit 28-Feb-12 14:03:29

Fringe: RUN2-Loads, A2:Static Subcase, Stress Tensor, , von Mises, (NON-LAYERED)

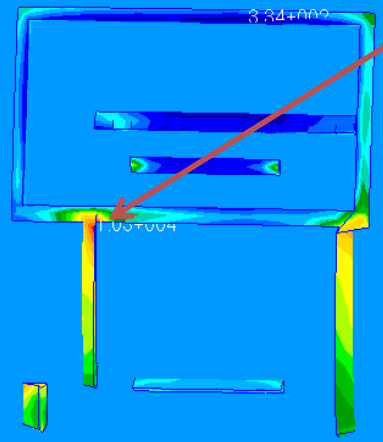


Max Stress = 10,200.psi

Weld area

MSC FEA 2010.1.2 64-Bit 28-Feb-12 14:10:36

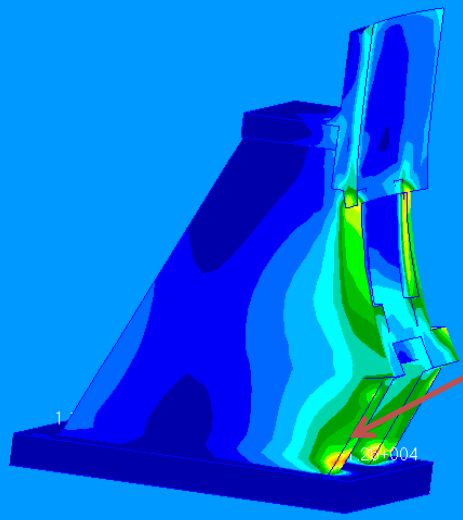
Fringe: RUN2-Loads, A2:Static Subcase, Stress Tensor, , von Mises, (NON-LAYERED)



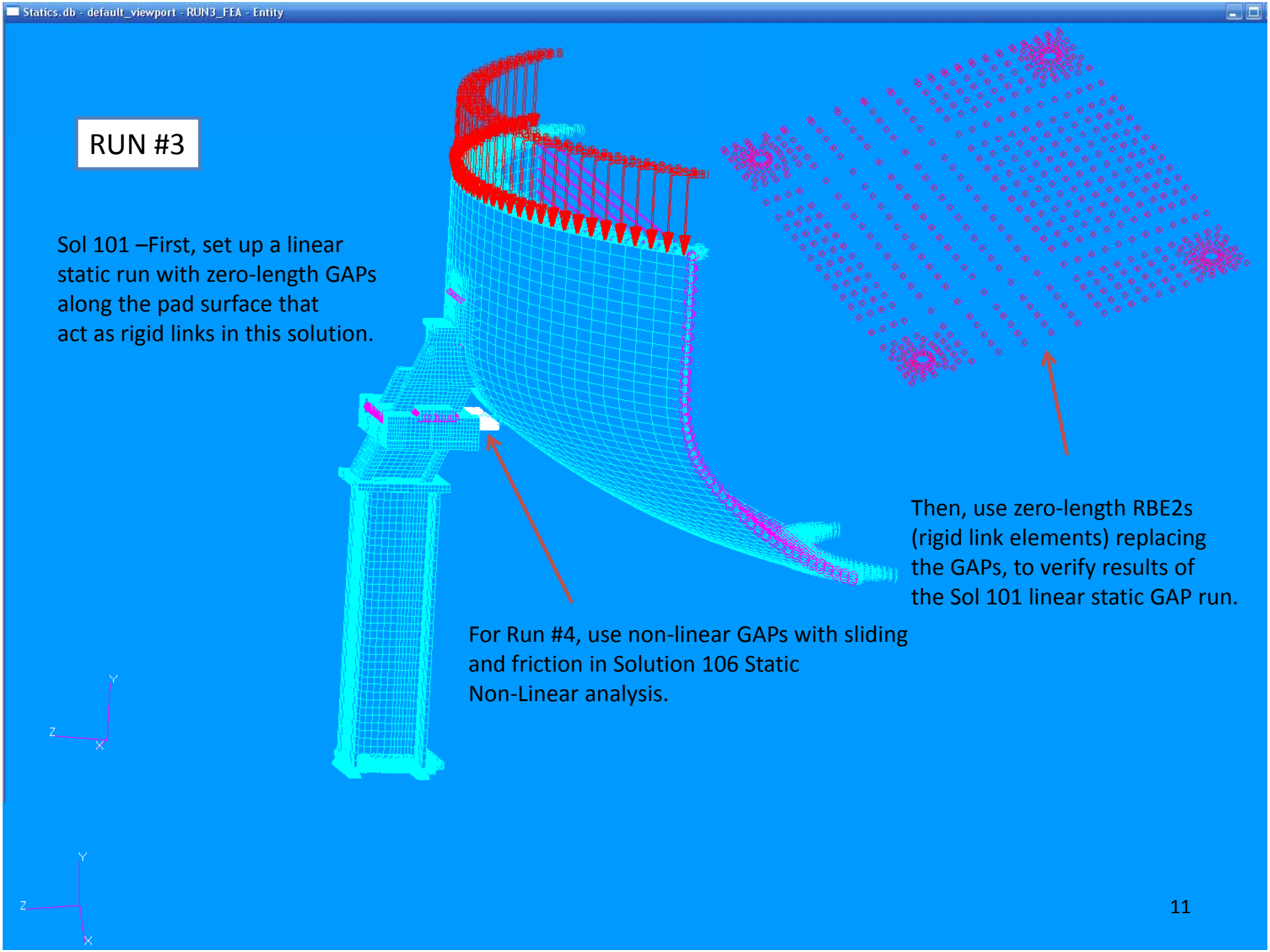
Welds between the Chair and the VV

MSC FEA 2010.1.2 64-Bit 28-Feb-12 14:14:08

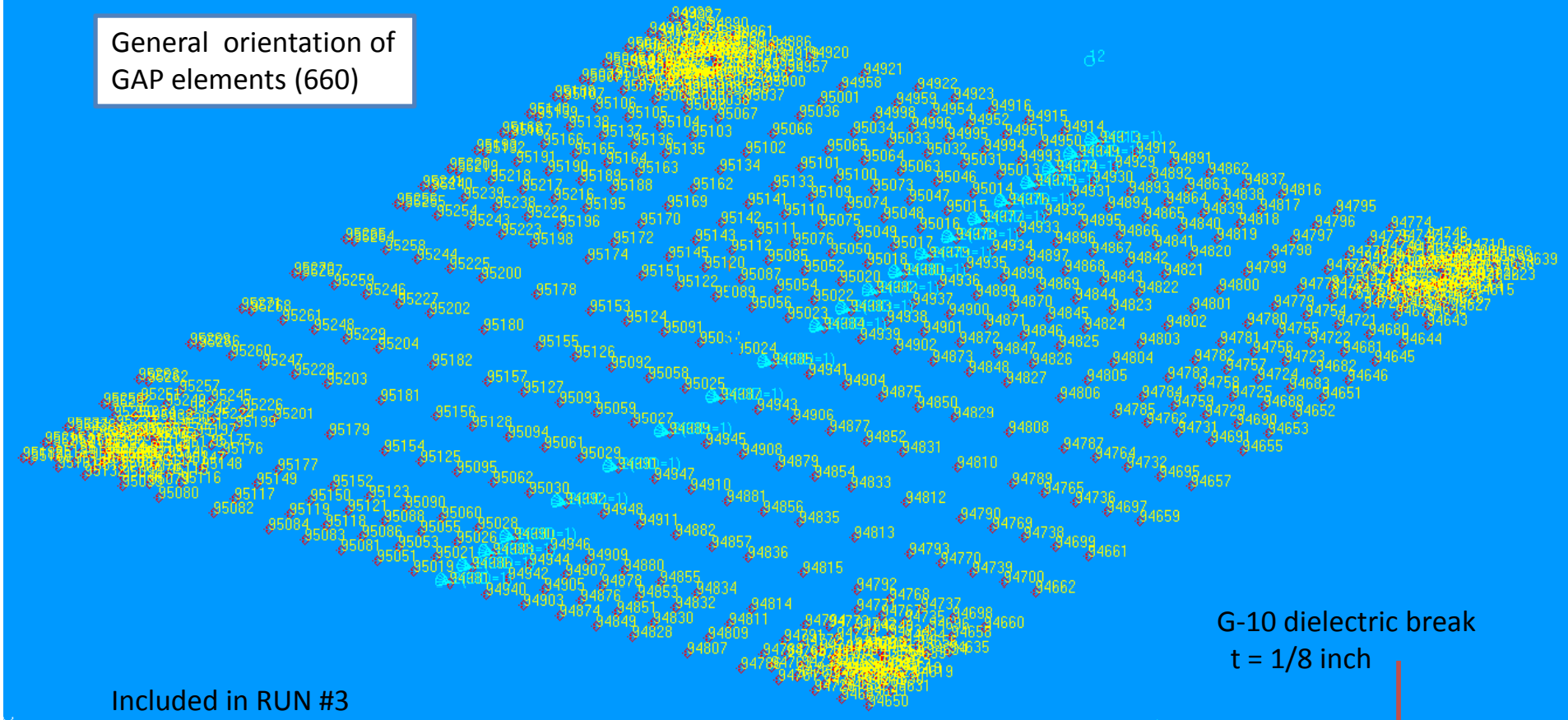
Fringe: RUN2-Loads, A2:Static Subcase, Stress Tensor, , von Mises, (NON-LAYERED)



Max Stress = 12,500.psi

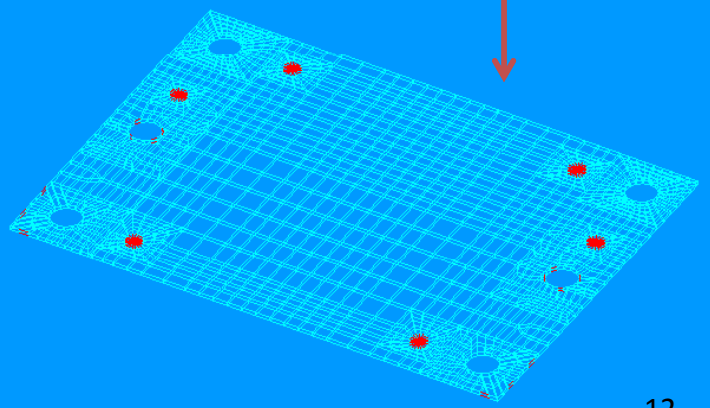

Statics.db - default_viewport - RUN3_FEA - Entity
RUN #3
Sol 101 –First, set up a linear static run with zero-length GAPs along the pad surface that act as rigid links in this solution.
Then, use zero-length RBE2s (rigid link elements) replacing the GAPs, to verify results of the Sol 101 linear static GAP run.
For Run #4, use non-linear GAPs with sliding and friction in Solution 106 Static Non-Linear analysis.
Y
Z
X
Y
Z
X

General orientation of GAP elements (660)

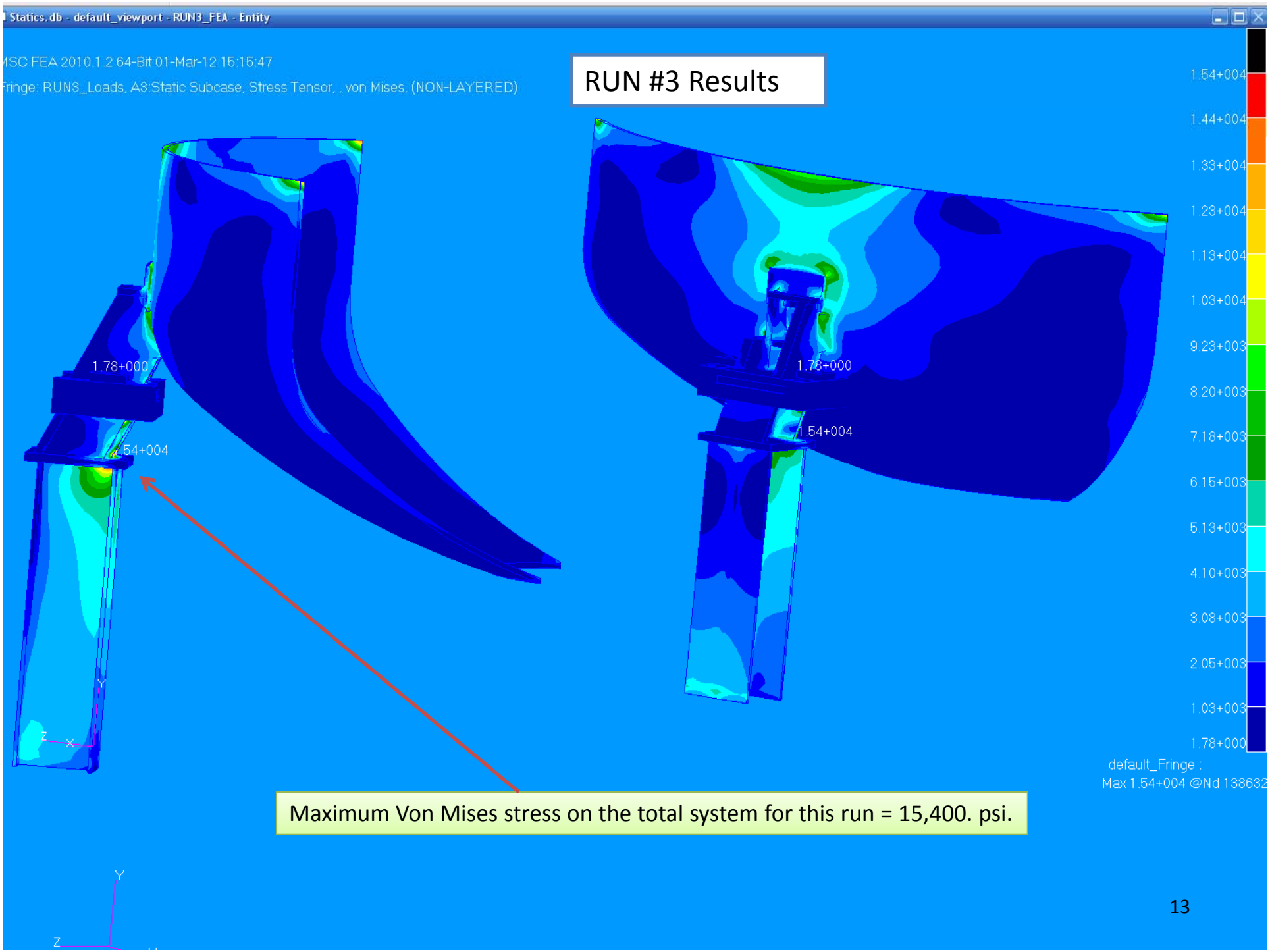


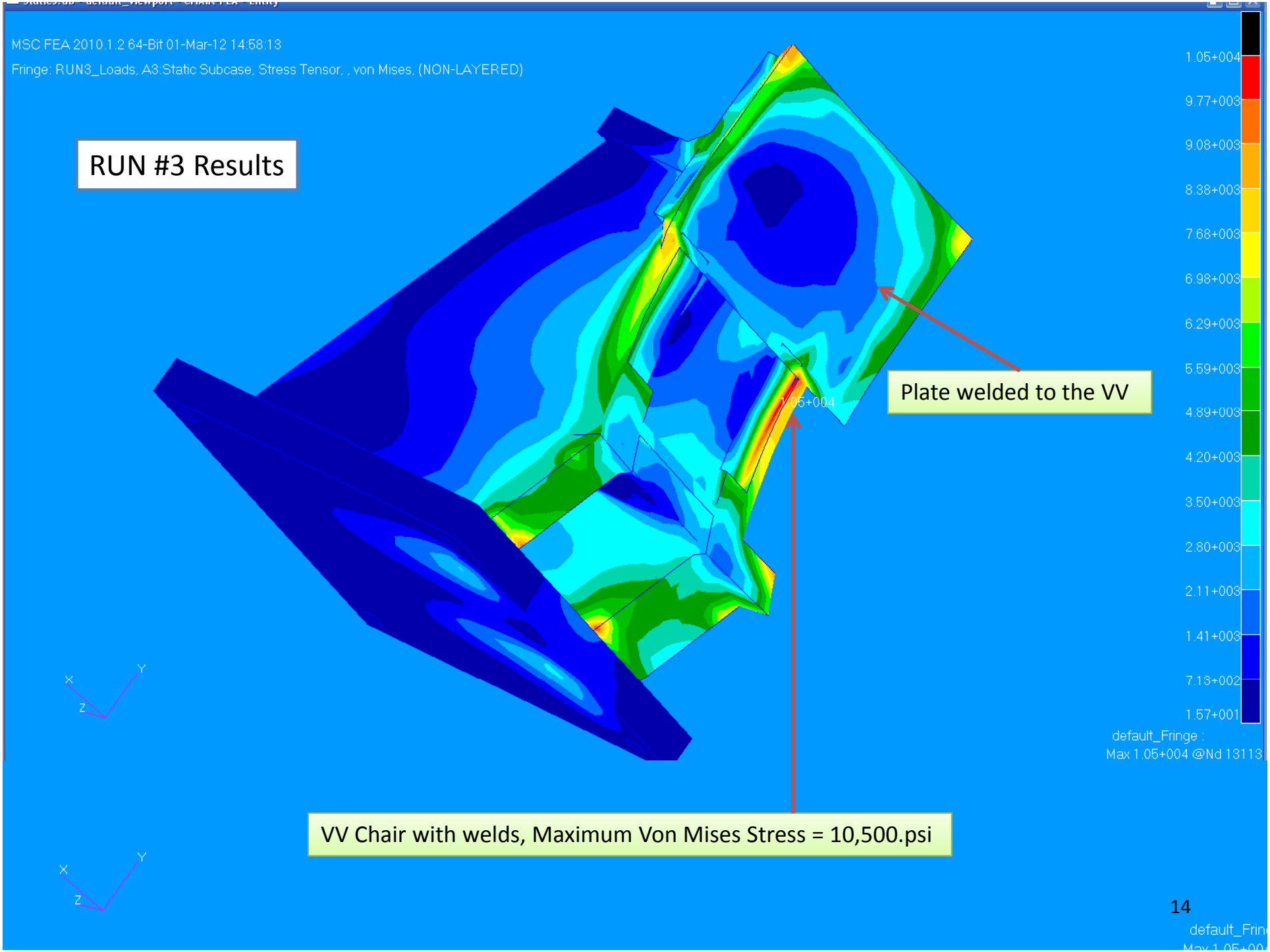
Included in RUN #3

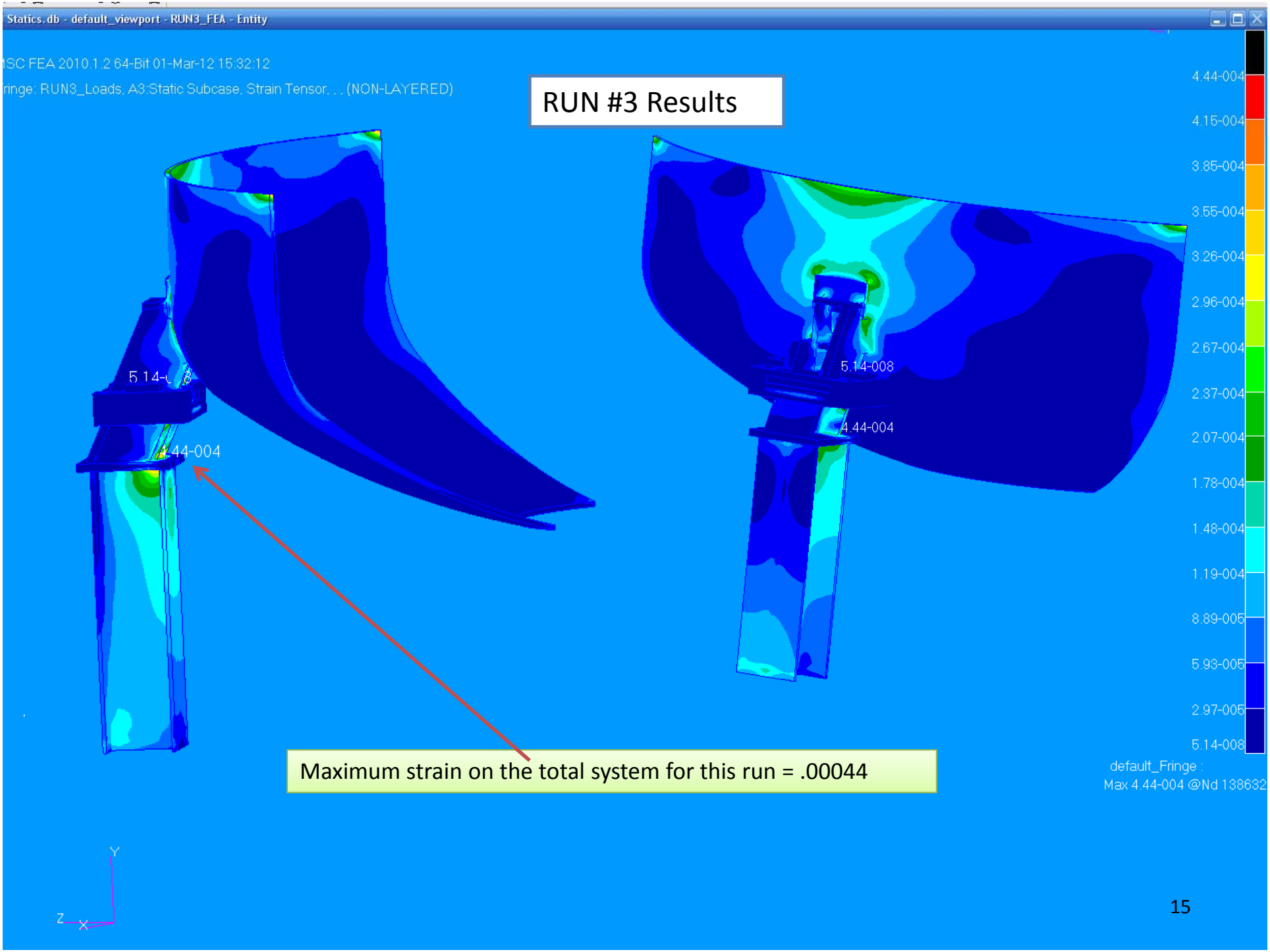
```
PARAM     POST     0
PARAM    PRTMAXIM YES
$ Elements and Element Properties for region : Sliding-Gaps
PGAP      1        0.              3.+7     500.     1.+7     .3       .3
         -1.
$ Pset: "Sliding-Gaps" will be imported as: "pgap.1"
CGAP      94612    1       102192   127702   0.       -1.      0.
CGAP      94613    1       102195   128013   0.       -1.      0.
CGAP      94614    1       102199   128016   0.       -1.      0.
CGAP      94615    1       102201   128015   0.       -1.      0.
CGAP      94616    1       102204   131457   0.       -1.      0.
```

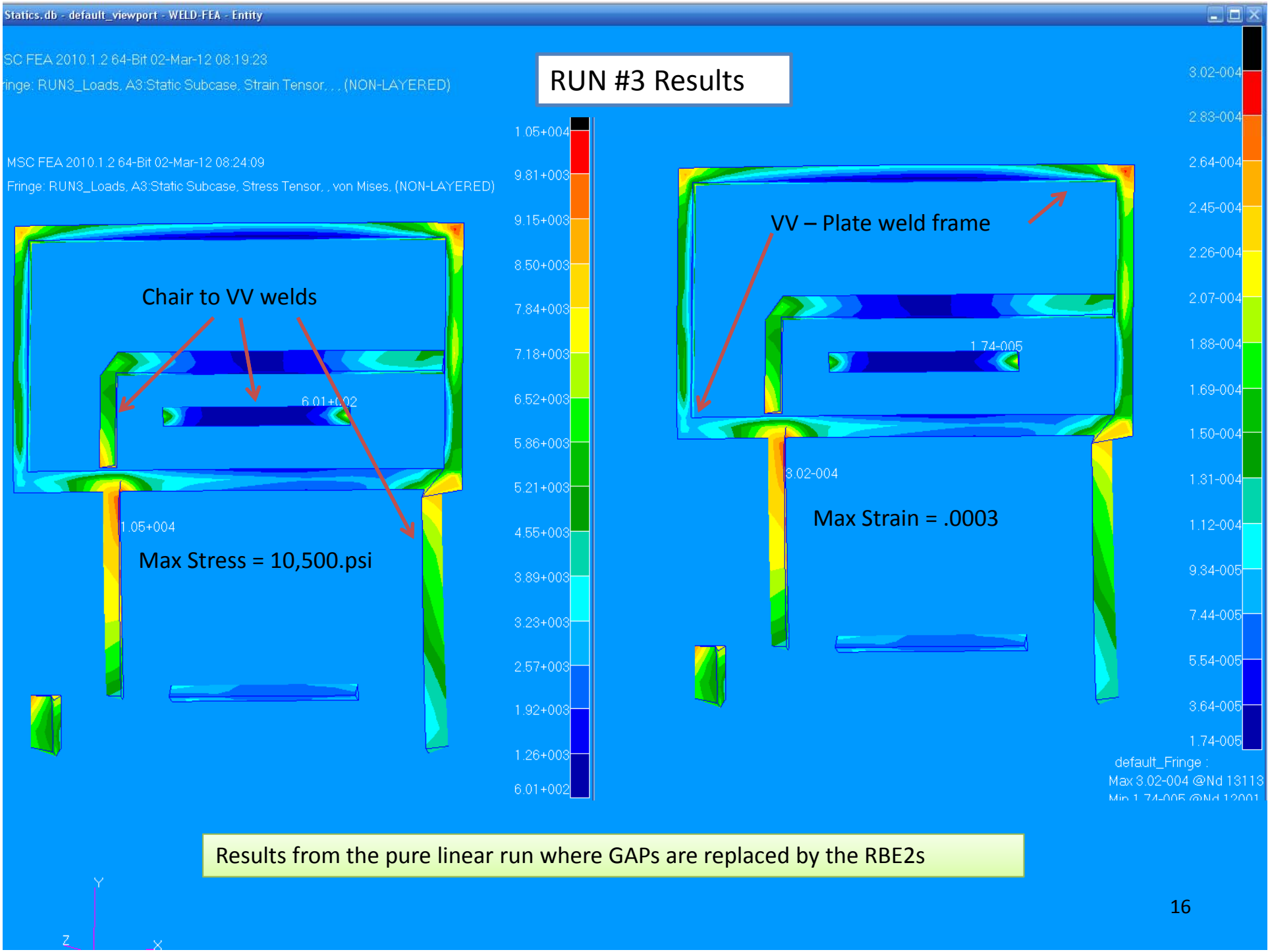


Between the cradle and Vertical support


Statics.db - default_viewport - RUN3_FEA - Entity
MSC FEA 2010.1.2 64-Bit 01-Mar-12 15:15:47
Fringe: RUN3_Loads, A3:Static Subcase, Stress Tensor, , von Mises, (NON-LAYERED)
RUN #3 Results
1.78+000
1.54+004
1.78+000
1.54+004
1.54+004
1.44+004
1.33+004
1.23+004
1.13+004
1.03+004
9.23+003
8.20+003
7.18+003
6.15+003
5.13+003
4.10+003
3.08+003
2.05+003
1.03+003
1.78+000
default_Fringe :
Max 1.54+004 @Nd 138632
Maximum Von Mises stress on the total system for this run = 15,400. psi.
Y
Z
X


MSC FEA 2010.1.2 64-Bit 01-Mar-12 14:58:13
Fringe: RUN3_Loads, A8:Static Subcase, Stress Tensor, , von Mises, (NON-LAYERED)
RUN #3 Results
1.05+004
9.77+003
9.08+003
8.38+003
7.68+003
6.98+003
6.29+003
5.59+003
4.89+003
4.20+003
3.50+003
2.80+003
2.11+003
1.41+003
7.13+002
1.57+001
default_Fringe :
Max 1.05+004 @Nd 13113
Plate welded to the VV
1.05+004
VV Chair with welds, Maximum Von Mises Stress = 10,500.psi

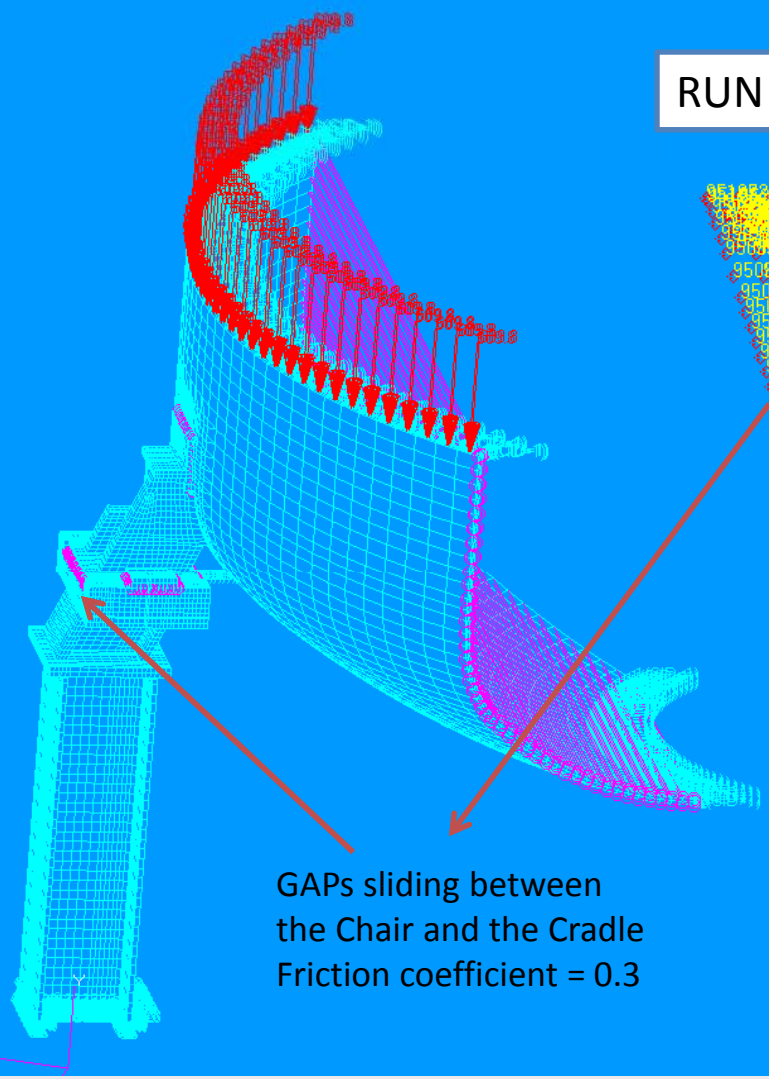

Statics.db - default_viewport - RUN3_FEA - Entity
ISC FEA 2010.1.2 64-Bit 01-Mar-12 15:32:12
ringe: RUN3_Loads, A3:Static Subcase, Strain Tensor, . . . (NON-LAYERED)
RUN #3 Results
4.44-004
4.15-004
3.85-004
3.55-004
3.26-004
2.96-004
2.67-004
2.37-004
2.07-004
1.78-004
1.48-004
1.19-004
8.89-005
5.93-005
2.97-005
5.14-008
default_Fringe :
Max 4.44-004 @Nd 138632
5.14-008
4.44-004
4.44-004
Maximum strain on the total system for this run = .00044
Y
Z
X

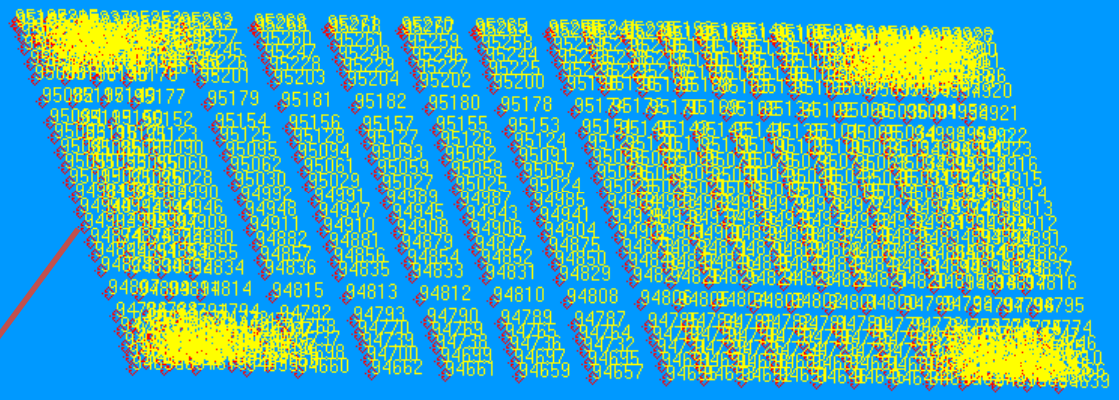


Results from the pure linear run where GAPs are replaced by the RBE2s

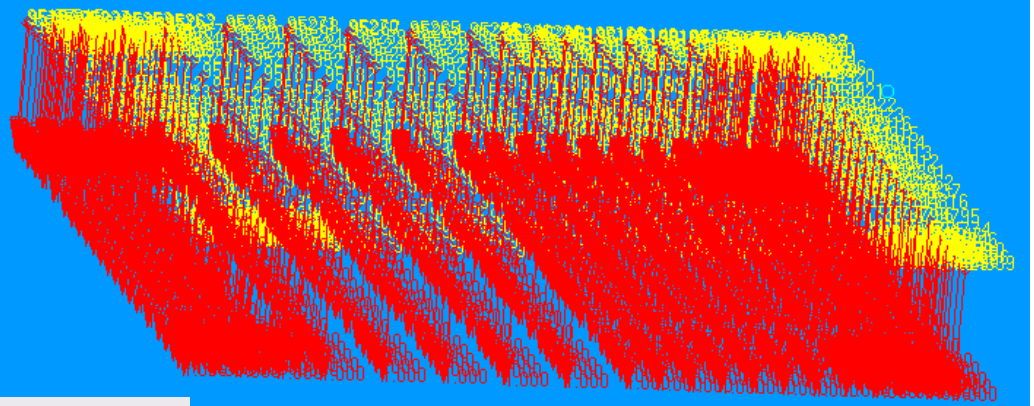
Statics.db - default_viewport - RUN4-106NL-FEA - Entity

RUN #4 Non Linear Static Solution (106)





GAPs sliding between
the Chair and the Cradle
Friction coefficient = 0.3



GAPs orientation in the -Y direction

	Type	Scale Factor	Priority
Slide_Fic_cen	Displacement	1.	Add
Support_Bot	Displacement	1.	Add
VV-Fixity	Displacement	1.	Add
VV-Fixity-Bot	Displacement	1.	Add
Pres40000	Pressure	1.	Add

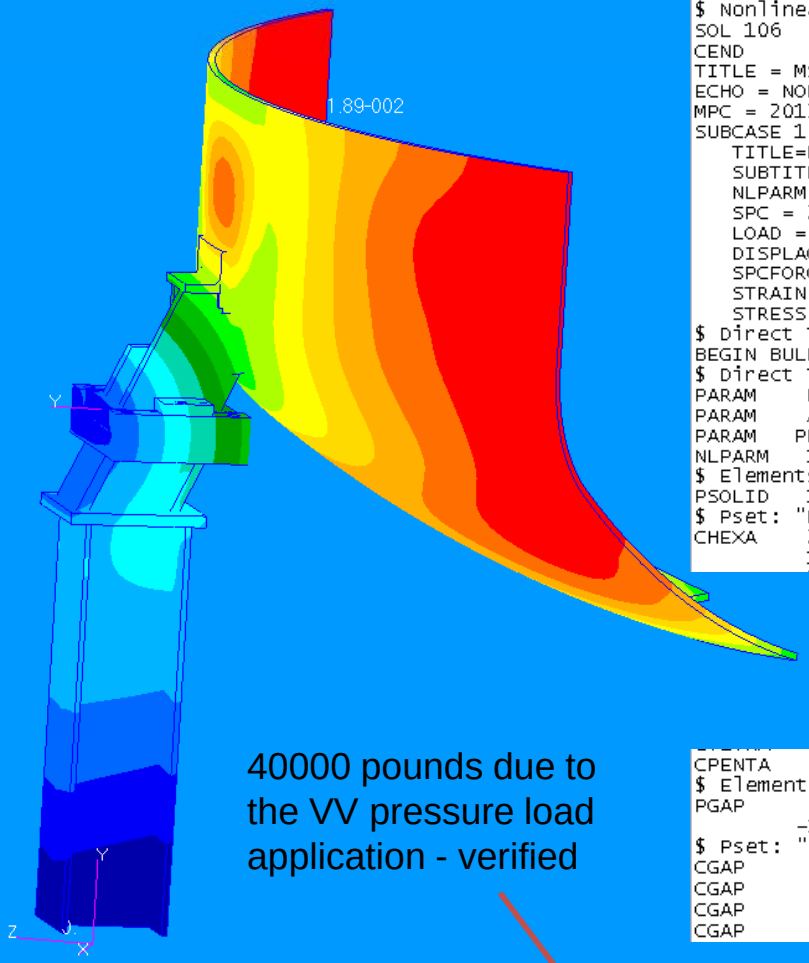
Load Case “RUN4-Loads”

Statics.db - default_viewport - RUN4-106NL-FEA - Entity

MSC FEA 2010.1.2 64-Bit 06-Mar-12 10:02:14

Fringe: RUN4-Loads, A4:Non-linear: 100. % of Load, Displacements, Translational, Magnitude, (NON-LAYERED)

RUN #4 -Results




```
$ Nonlinear Static Analysis, Database
SOL 106
CEND
TITLE = MSC.NASTRAN JOB CREATED ON 17-FEB-12 AT 08:48:38
ECHO = NONE
MPC = 20134
SUBCASE 1
   TITLE=Non Linear
   SUBTITLE=RUN4-Loads
   NLPARM = 1
   SPC = 2
   LOAD = 2
   DISPLACEMENT(SORT1,REAL)=ALL
   SPCFORCES(SORT1,REAL)=ALL
   STRAIN(SORT1,REAL,VONMISES,STRCUR,BILIN)=ALL
   STRESS(SORT1,REAL,VONMISES,BILIN)=ALL
$ Direct Text Input for this Subcase
BEGIN BULK
$ Direct Text Input for Bulk Data
PARAM    POST    0
PARAM    AUTOSPC YES
PARAM    PRTMAXIM YES
NLPARM   1       10              AUTO    5       25              NO
$ Elements and Element Properties for region : HexWedTet
PSOLID   1       1       0
$ Pset: "HexWedTet" will be imported as: "psolid.1"
CHEXA    2793    1       14407   14420   14419   14406   14606   14627
         14626   14605
```

Group – RUN4-106NL-FEA
Input – Run4-106NL-fea.bdf
Load -- RUN4-Loads
Output – Run4-106NL-fea.xdb

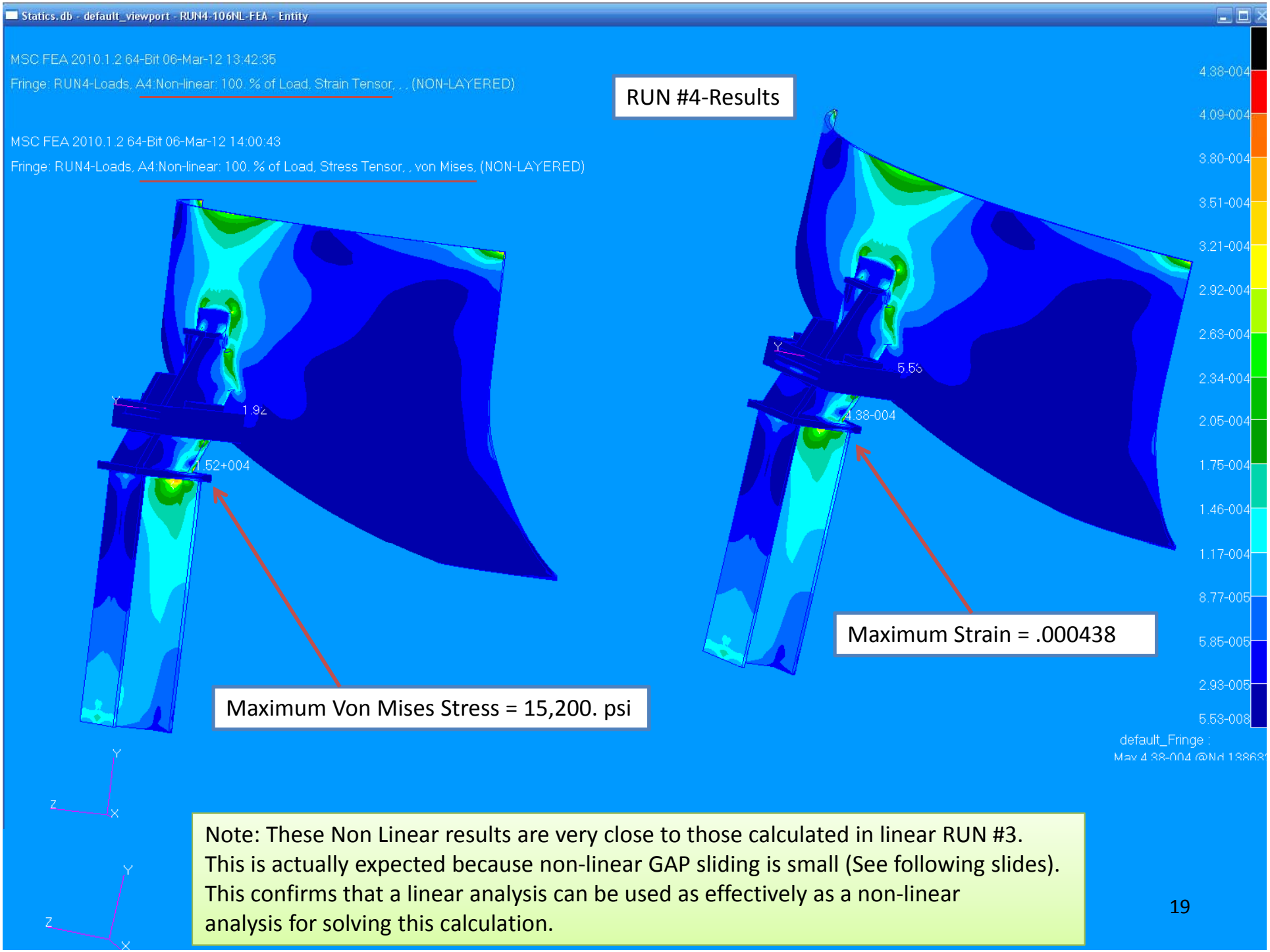
```
CPENTA   95277   1       16149   12736   12733   16152   12576   12573
$ Elements and Element Properties for region : Sliding-Gaps
PGAP     2       0.              3.+7    500.    1.+7    .3      .3
         -1.
$ Pset: "Sliding-Gaps" will be imported as: "pgap.2"
CGAP     94612   2       102192  127702                          2
CGAP     94613   2       102195  128013                          2
CGAP     94614   2       102199  128016                          2
CGAP     94615   2       102201  128015                          2
```

40000 pounds due to the VV pressure load application - verified

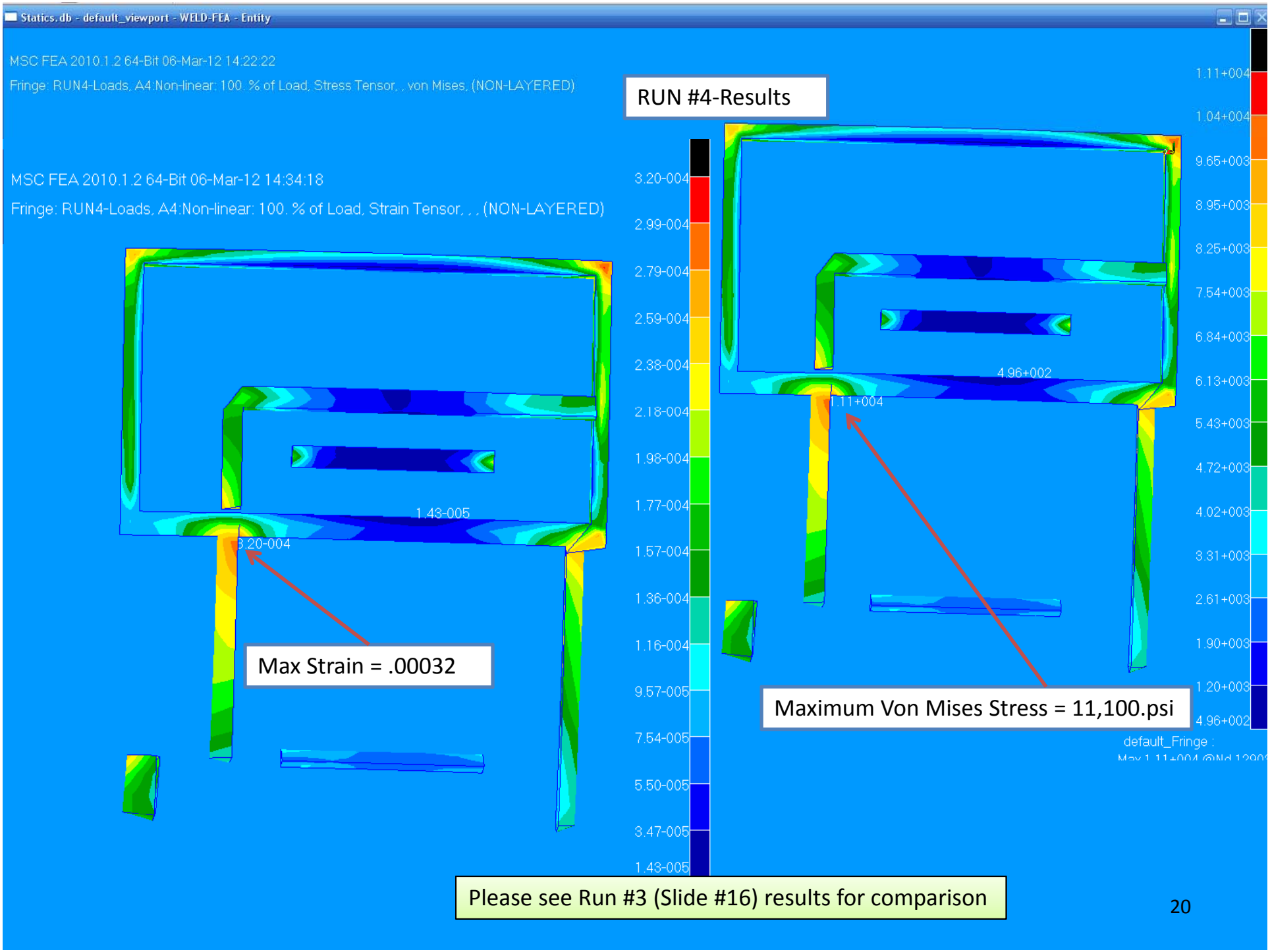
```
     RESULTANTS ABOUT ORIGIN OF SUPERELEMENT BASIC COORDINATE SYSTEM IN SUPERELEMENT BASIC SYSTEM COORDINATES.
0                                                 OLOAD    RESULTANT
  SUBCASE/     LOAD
  DAREA ID     TYPE          T1              T2              T3              R1              R2              R3
0        1       FX   0.000000E+00            ----            ----            ----   0.000000E+00   0.000000E+00
                 FY            ----  -3.998594E+04            ----  2.221206E+06            ----  -9.220052E+05
                 FZ            ----            ----  0.000000E+00  0.000000E+00   0.000000E+00            ----
                 MX            ----            ----            ----  0.000000E+00            ----            ----
                 MY            ----            ----            ----            ----   0.000000E+00            ----
                 MZ            ----            ----            ----            ----            ----   0.000000E+00
              TOTALS  0.000000E+00 -3.998594E+04  0.000000E+00  2.221206E+06  0.000000E+00 -9.220052E+05
1    MSC.NASTRAN JOB CREATED ON 17-FEB-12 AT 08:48:38                                  MARCH    6, 2012  MSC.NASTRAN  6/19
```

1.89-002
1.77-002
1.64-002
1.52-002
1.39-002
1.26-002
1.14-002
1.01-002
8.84-003
7.58-003
6.31-003
5.05-003
3.79-003
2.53-003
1.26-003
0

default_Fringe :
Max 1.89-002 @Nd 5909

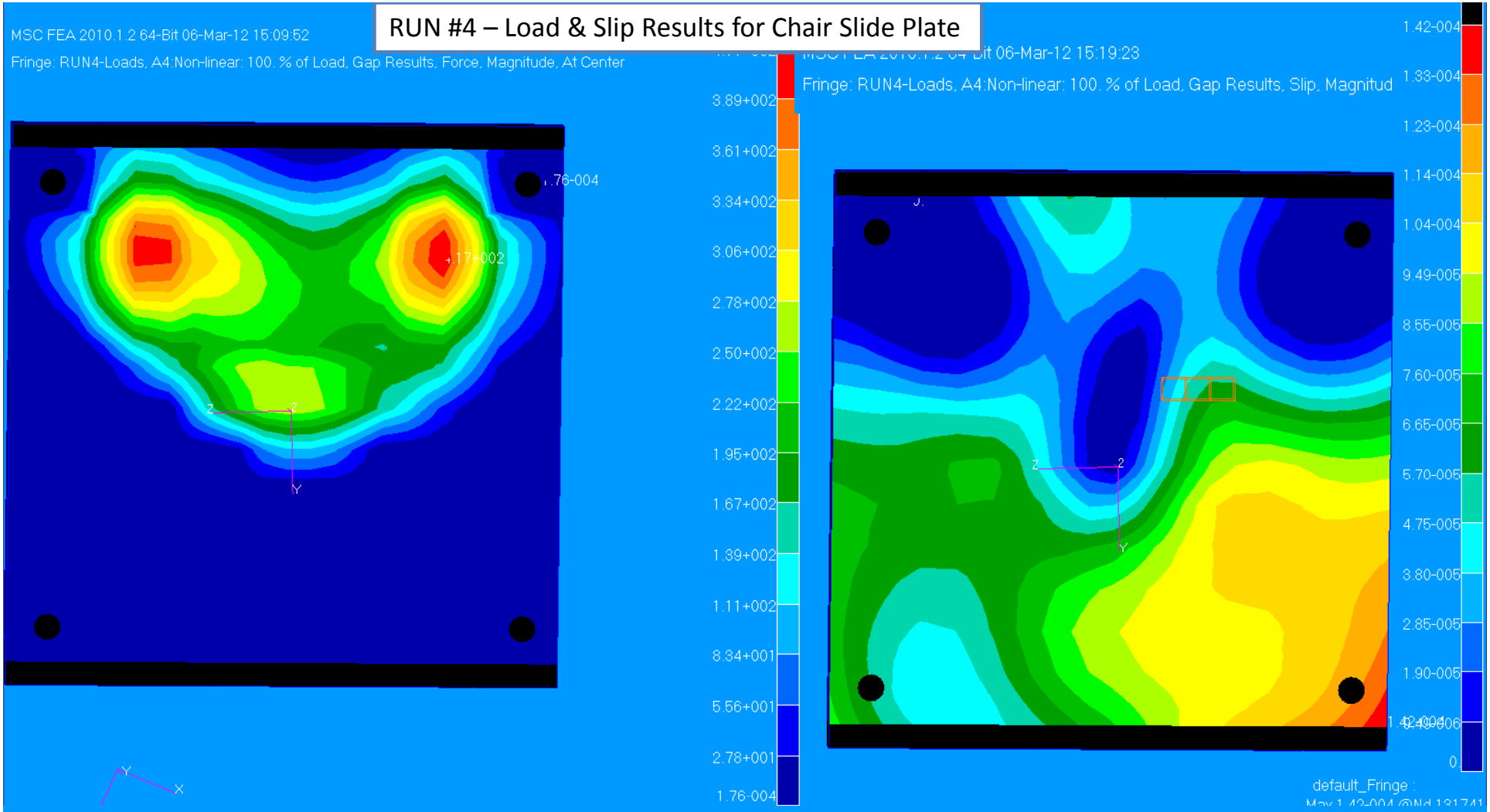


Note: These Non Linear results are very close to those calculated in linear RUN #3. This is actually expected because non-linear GAP sliding is small (See following slides). This confirms that a linear analysis can be used as effectively as a non-linear analysis for solving this calculation.



Please see Run #3 (Slide #16) results for comparison

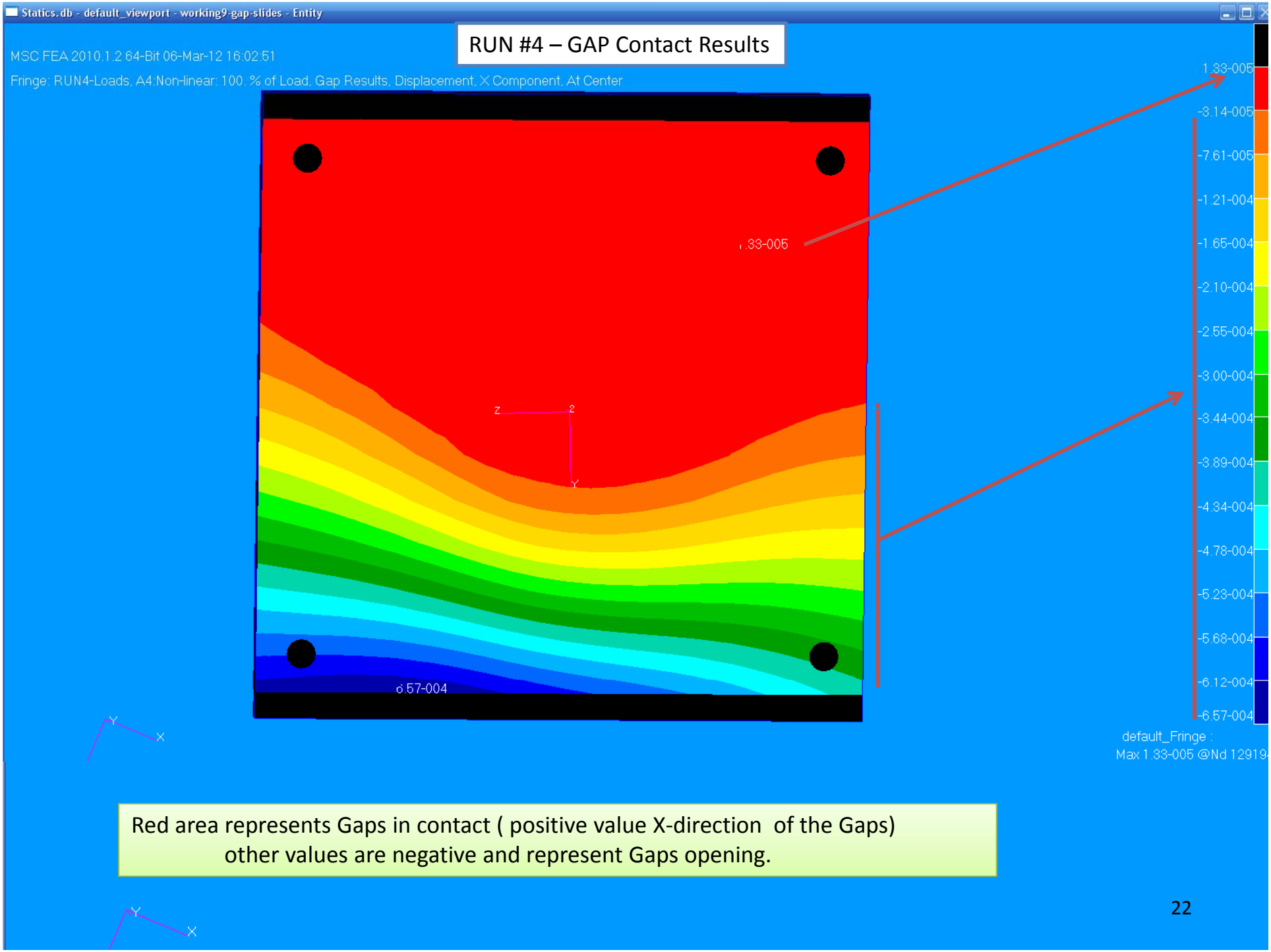
RUN #4 – Load & Slip Results for Chair Slide Plate



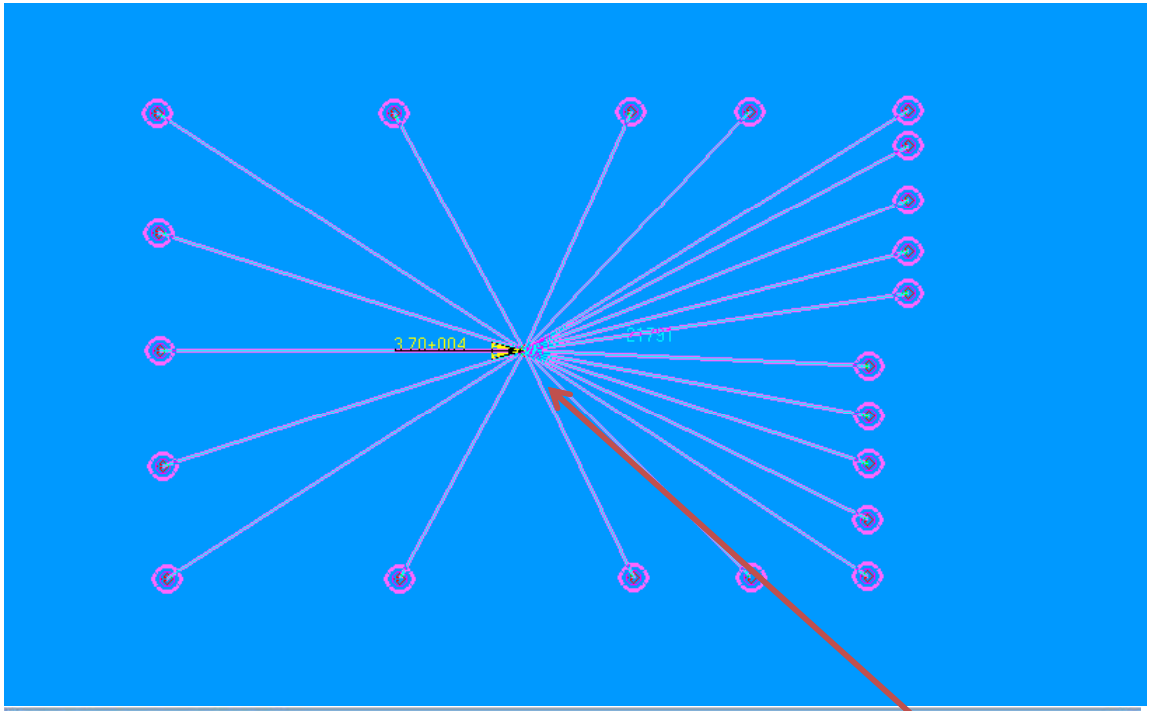
Gaps Load transfer distribution

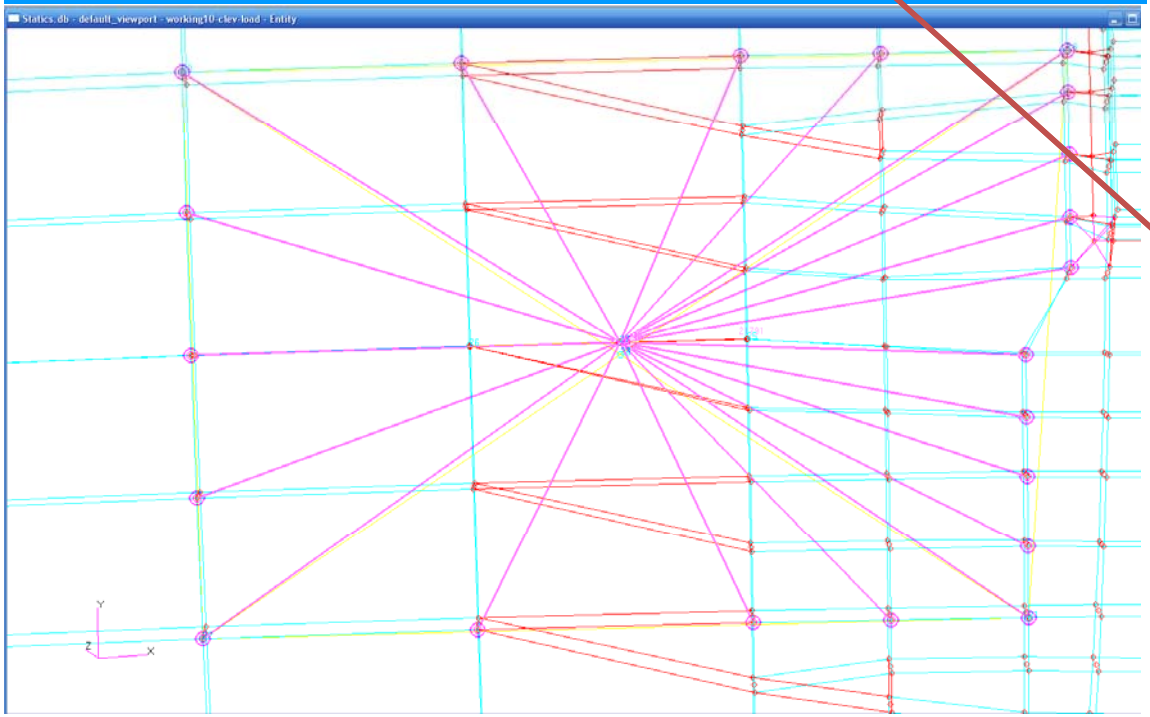
Gaps slipping distribution

Note : These results are based on the coefficient of friction = 0.3 for GAP “Y” and “Z” transverse directions



Red area represents Gaps in contact (positive value X-direction of the Gaps)
other values are negative and represent Gaps opening.





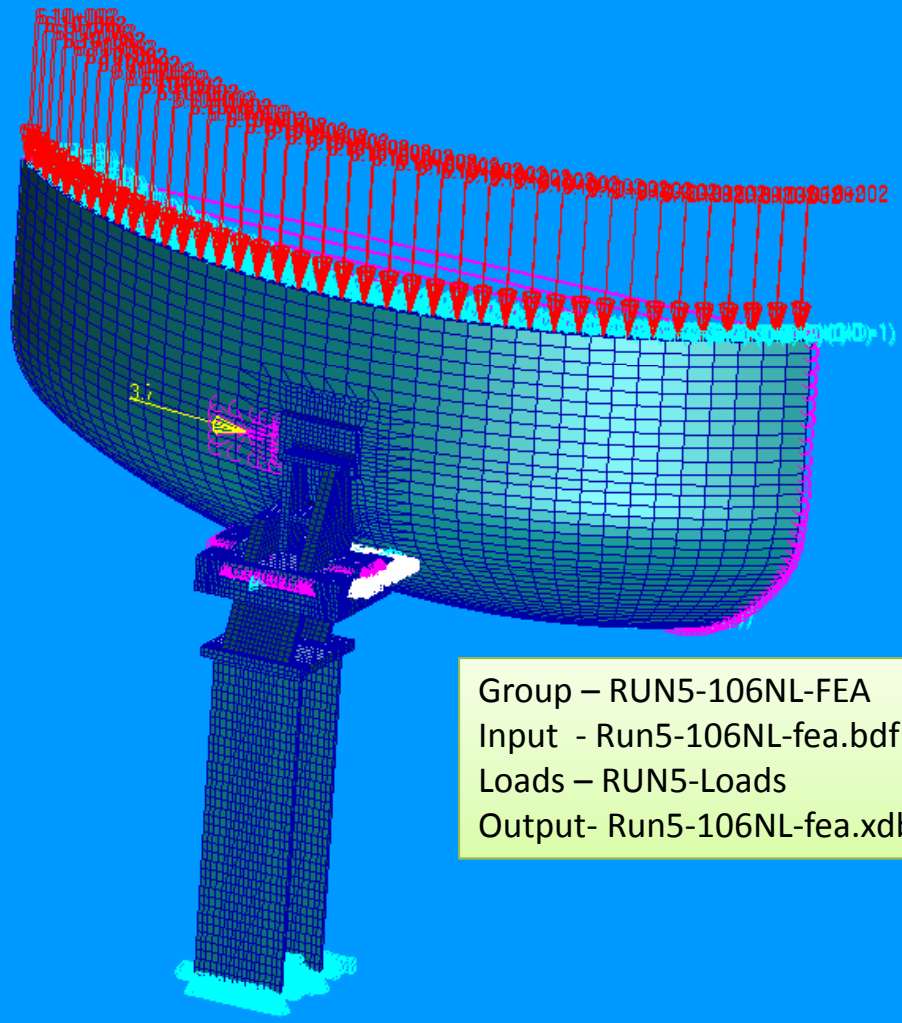
Changes for RUN #5

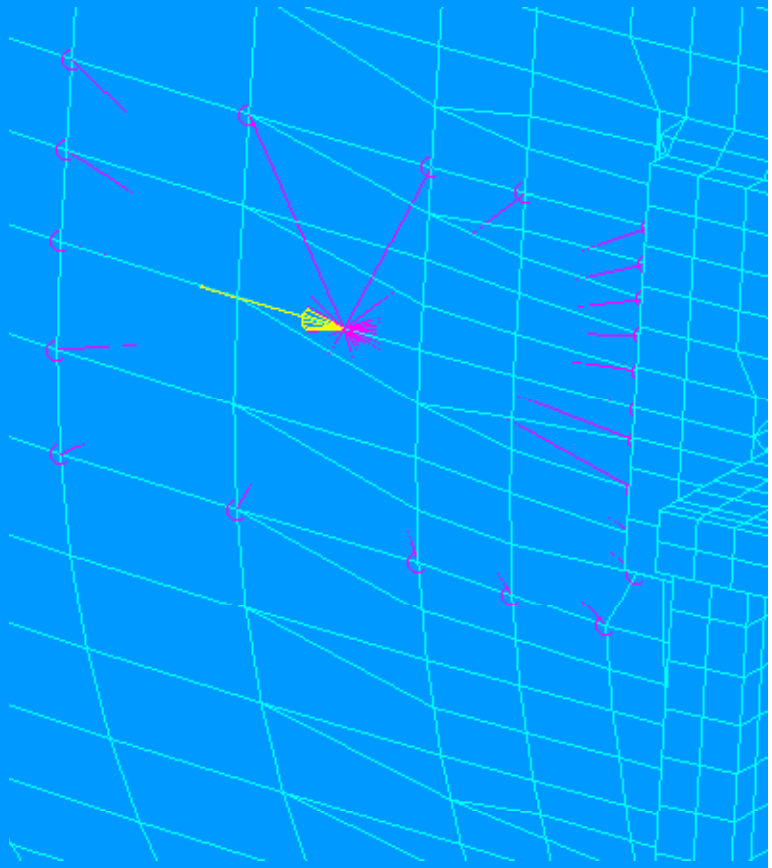
Introduction of the near-by Clevis force and its application is added to the Run #4 simulation.
The VV-chair was redesigned because of the interference created by the new TF coil link connections to the VV. Therefore, the clevis is placed very close to the VV-chair structure. The slides on the left show this closeness and the RIGID BODY formation to simulate this condition. This body consists of the central node to which outside nodes are connected rigidly.
Therefore, load applied at the central node distributes the force to the dependent nodes on the outside nodes which describe the maximum dimensions of the welded clevis.
A force equal to 37,000. lbs is applied at the central node using cylindrical Coordinate System #1 in the Theta – direction.

Central node is independent.

Statics.db - default_viewport - RUN5-106NL-FEA - Entity

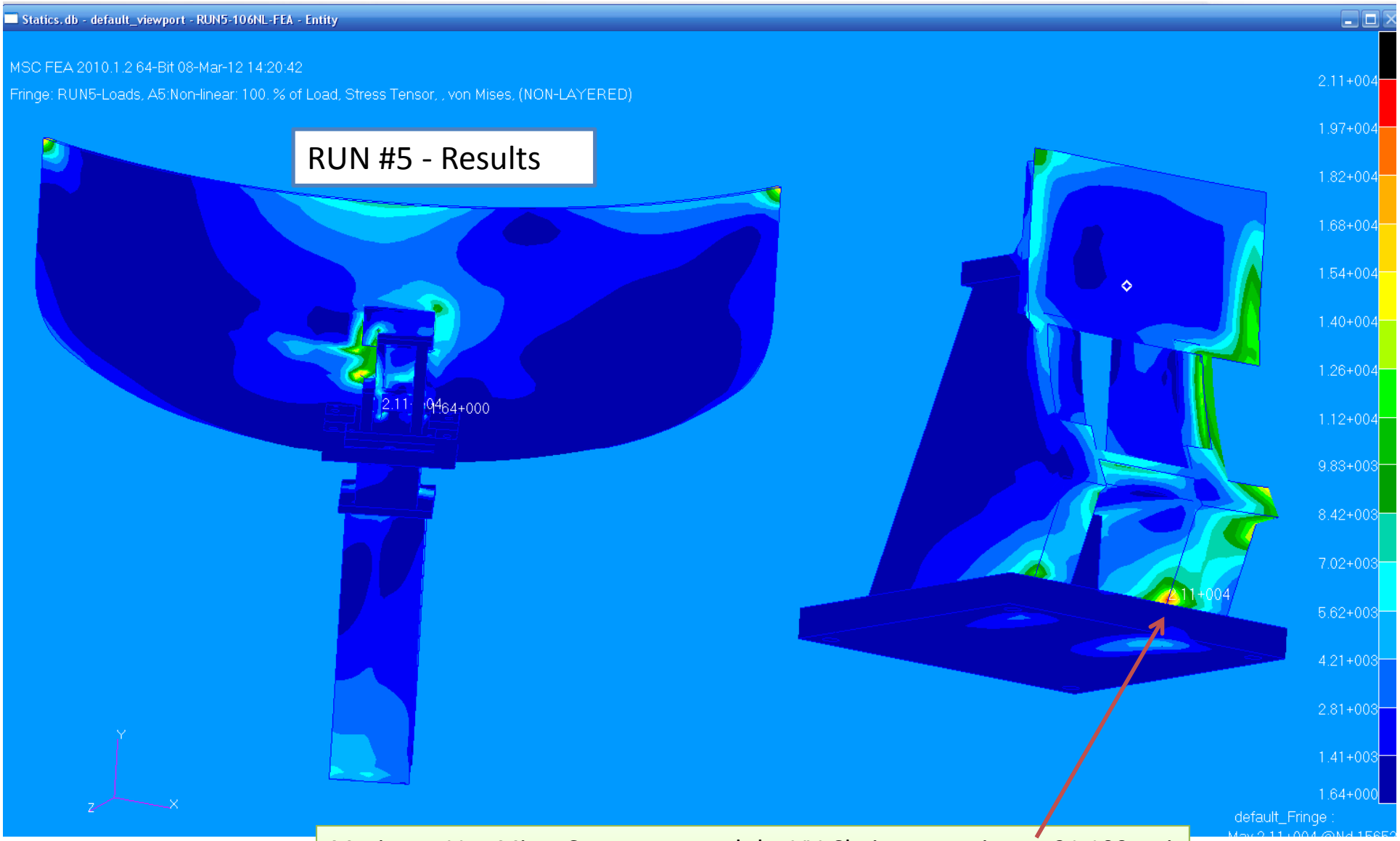
RUN #5 - Configuration



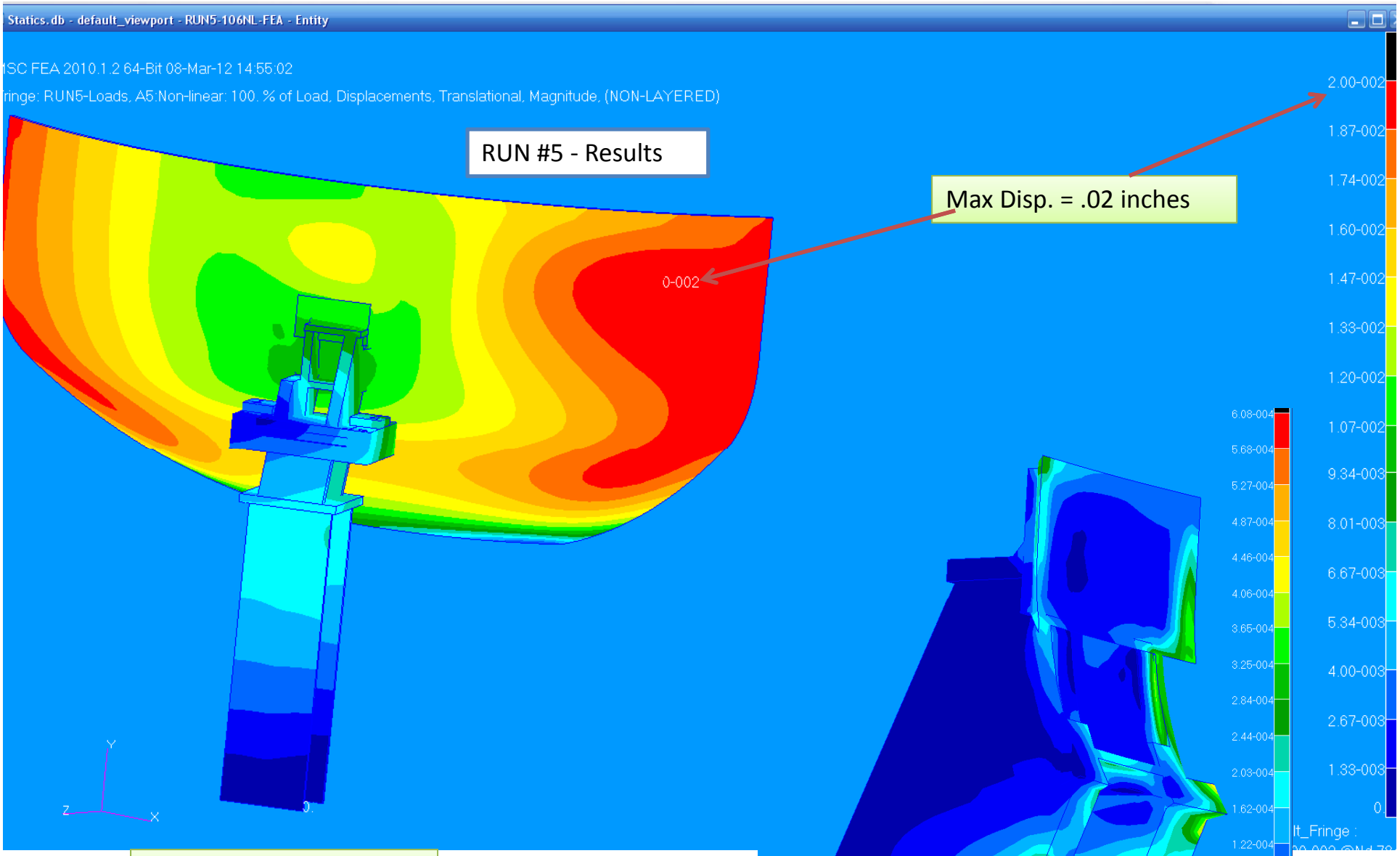


Group – RUN5-106NL-FEA
Input - Run5-106NL-fea.bdf
Loads – RUN5-Loads
Output- Run5-106NL-fea.xdb

RUN #5 is a Sol 106 (Non-Linear) run with B.C. and Load from Run #4 and additional rigid body simulation for the Clevis pad which resists the 37,000. lbs shear load parallel to the VV surface. (Yellow arrow)

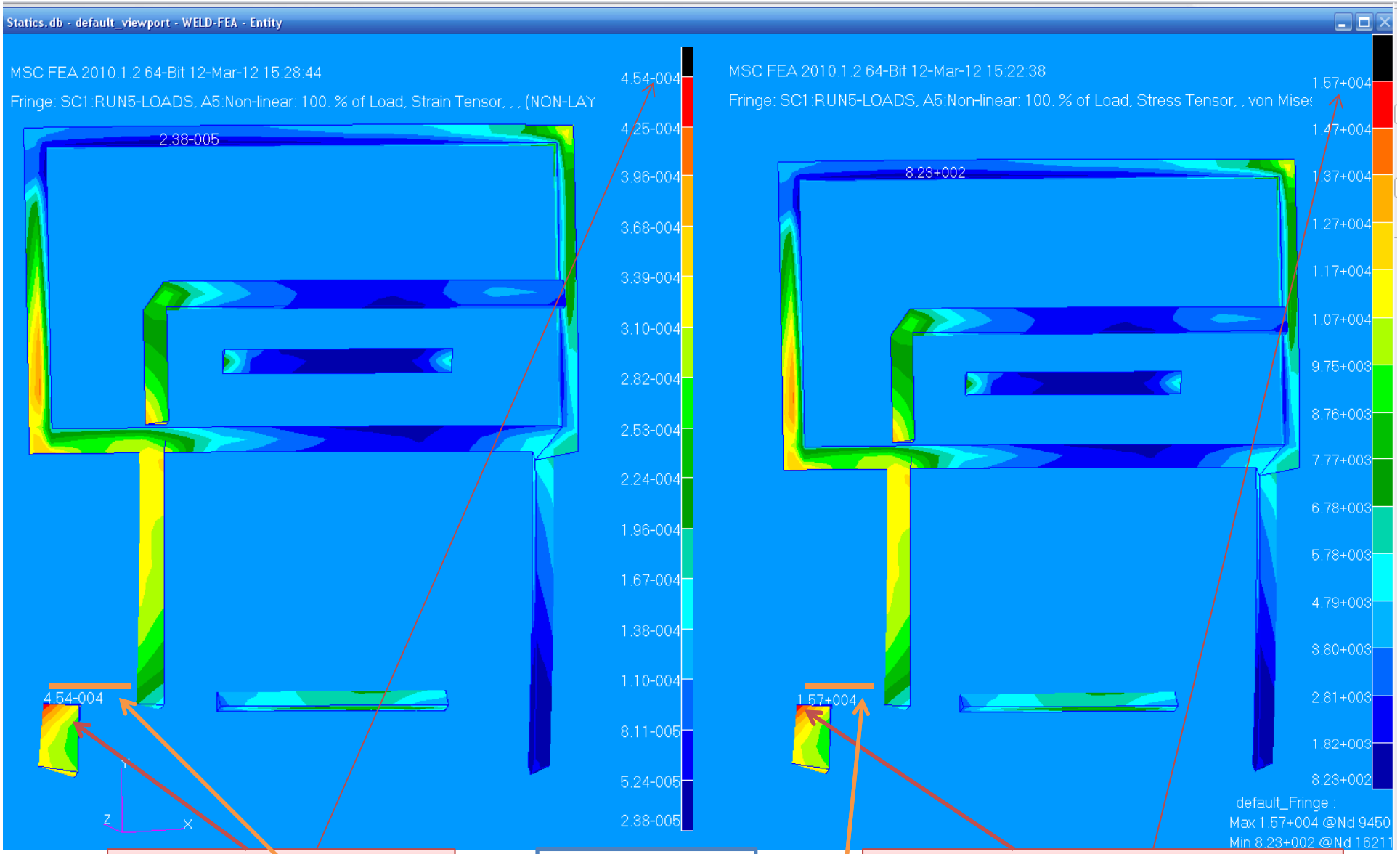


Maximum Von Mises Stresses around the VV-Chair connections = 21,100. psi at the Chair support. Welds seem to be O.K.



General displacements

Maximum strain = .000608



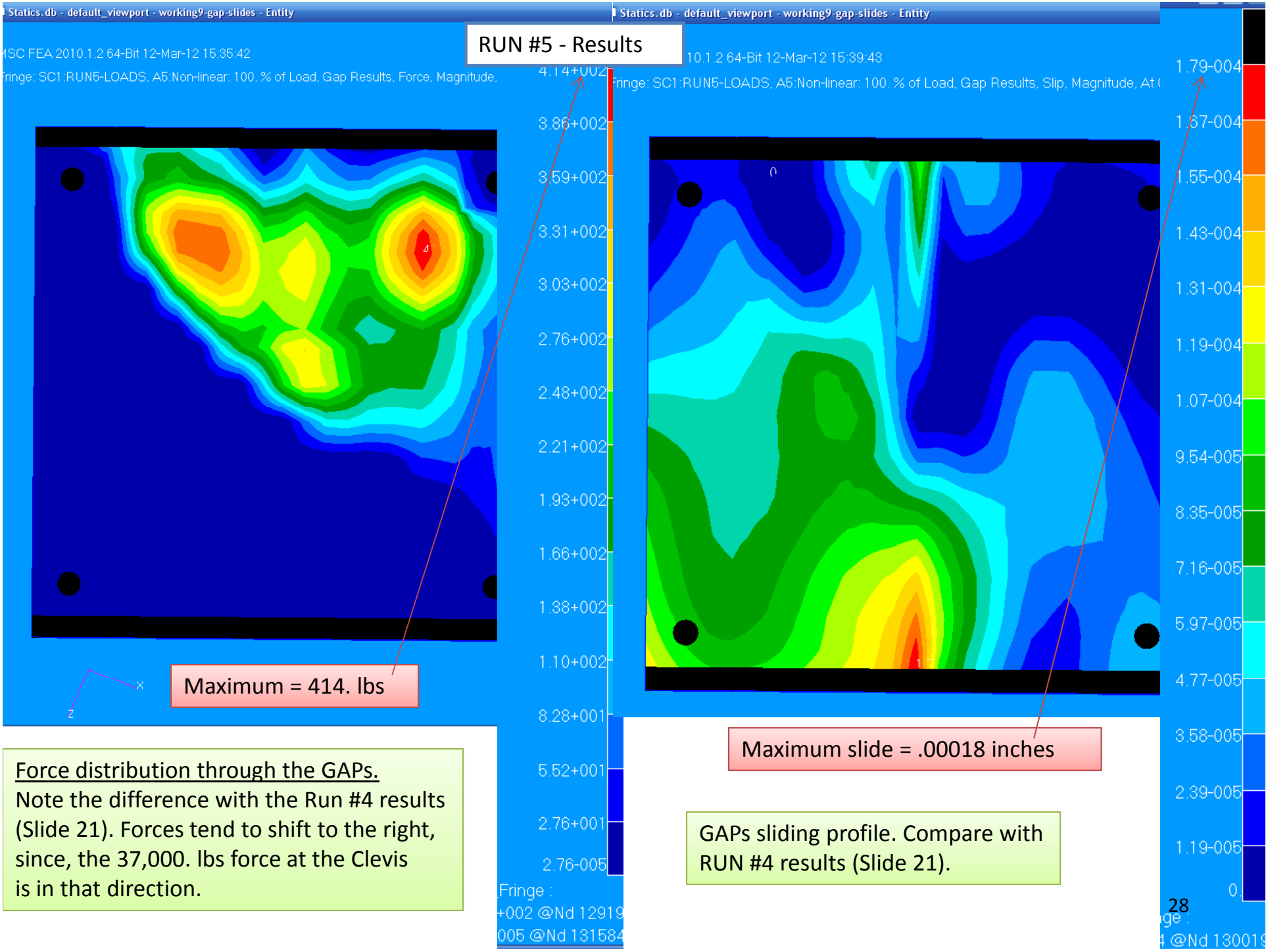
Maximum Strain = .00045

RUN #5 - Results

Maximum Von Mises Stress = 15,700. psi

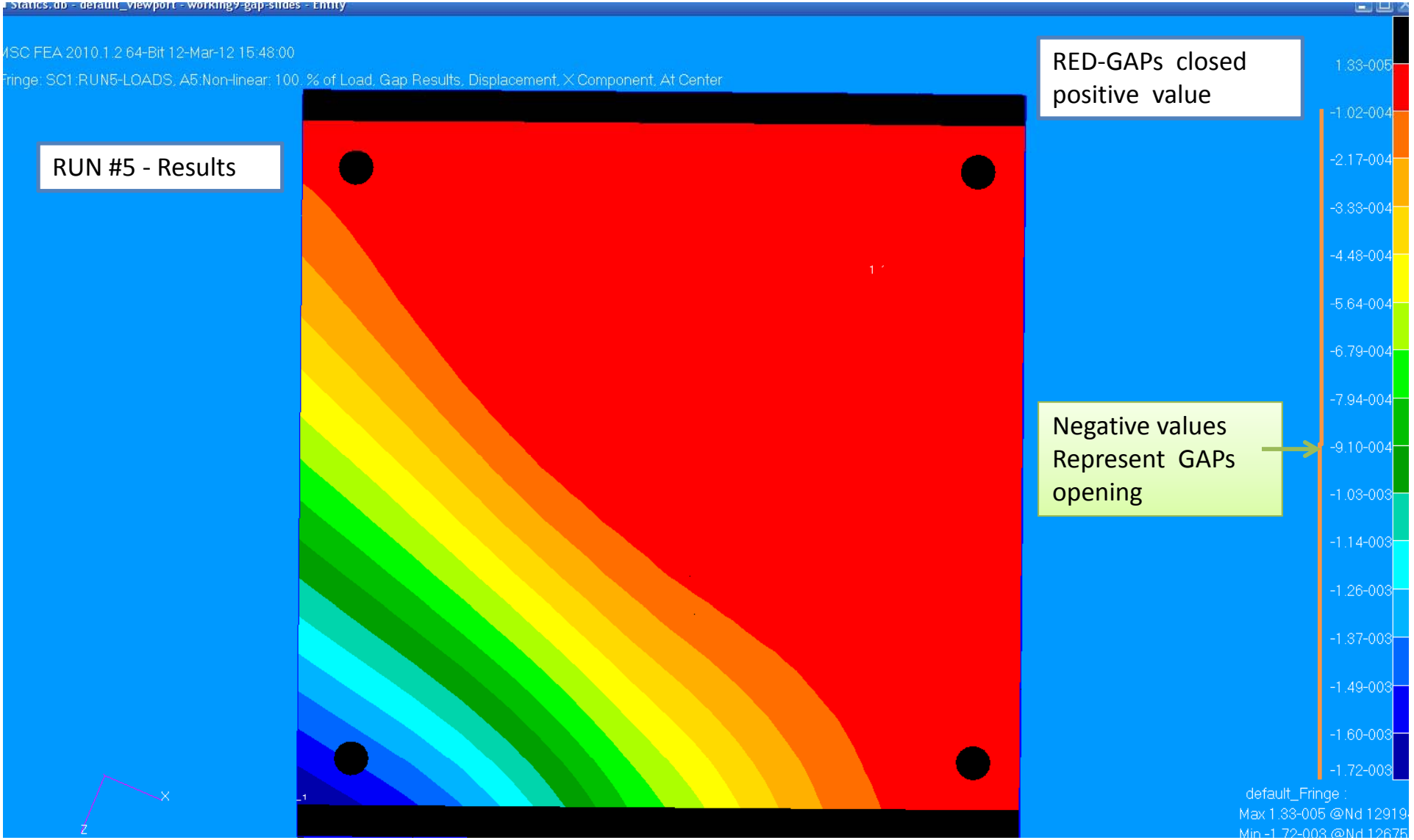
Note: If this location is possible to weld, it should decrease the maximum stress and/or strain levels.
Also see the welding slide below.

RUN #5 - Results

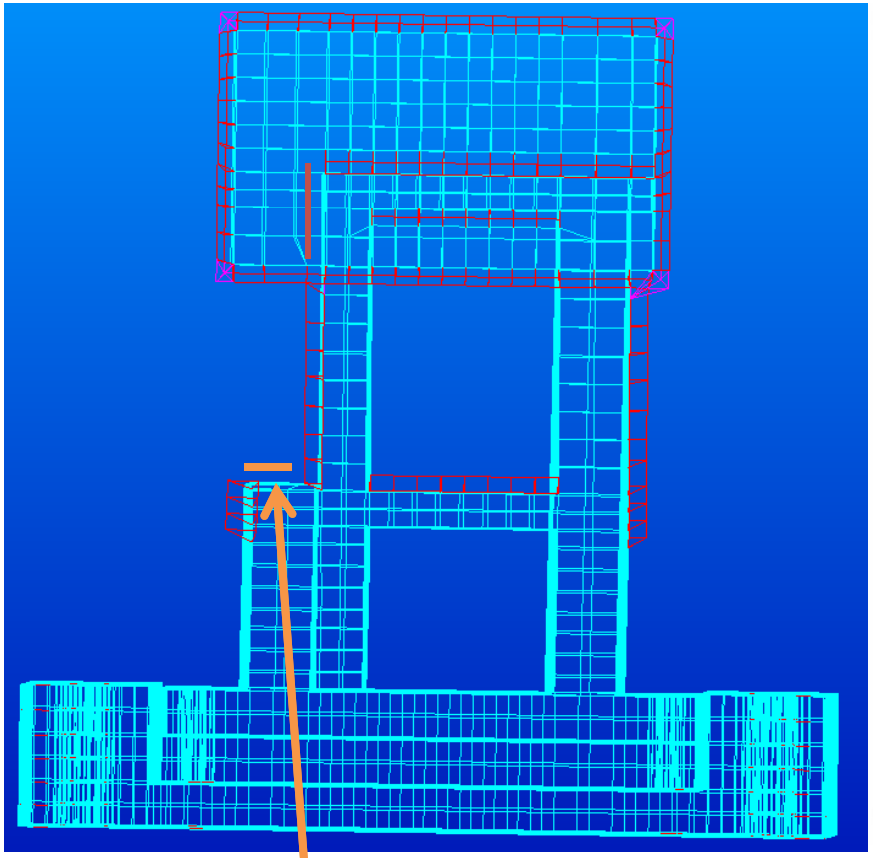


Force distribution through the GAPs.
Note the difference with the Run #4 results (Slide 21). Forces tend to shift to the right, since, the 37,000. lbs force at the Clevis is in that direction.

GAPs sliding profile. Compare with RUN #4 results (Slide 21).



Coordinate 2 controls (defines) the used GAPs. The X-direction (normal to page) is the principal gap direction which defines if the gap is open or closed.
Please see the ".bdf" input file for details.
(Compare with Run #4 results shown on Slide 22.)



Area that would be <u>extremely desirable</u> to weld, but, may not be readily accessible

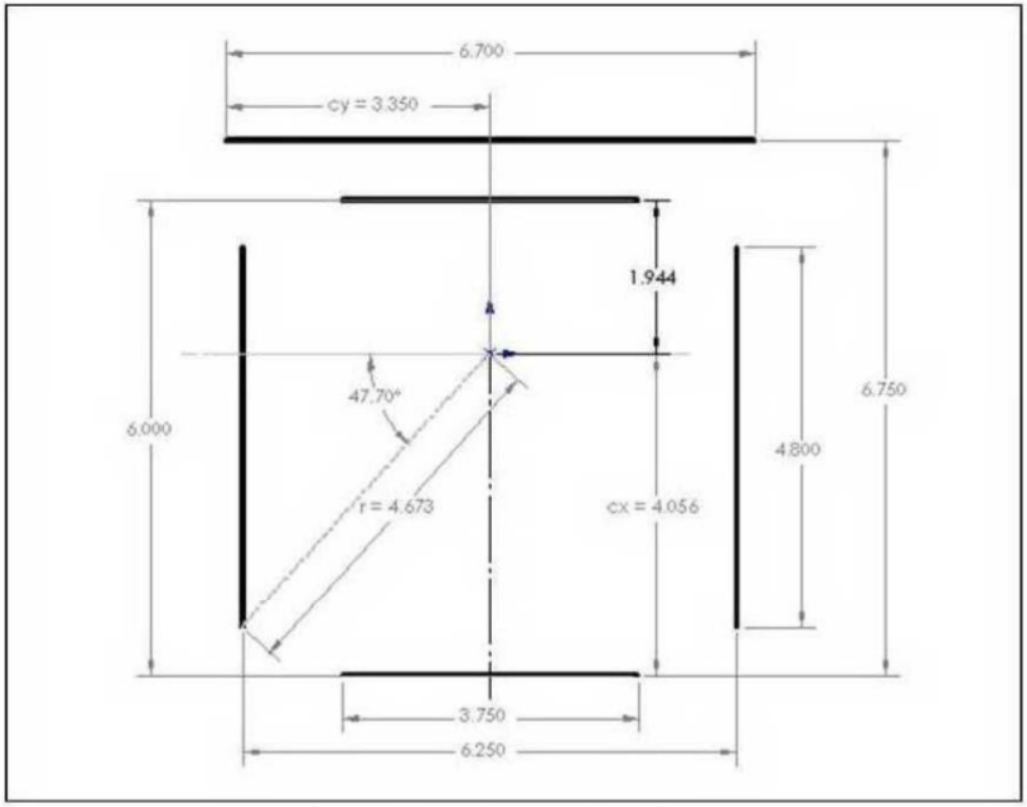
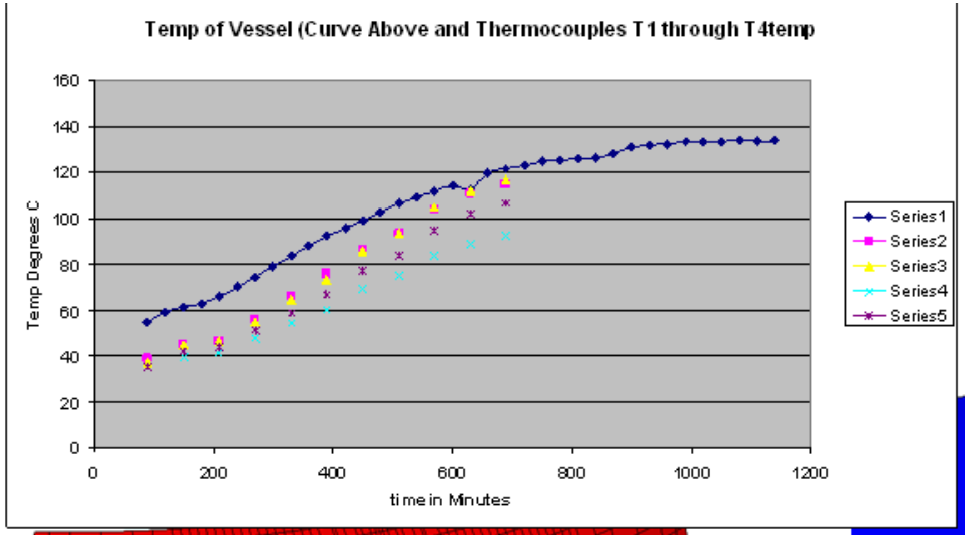


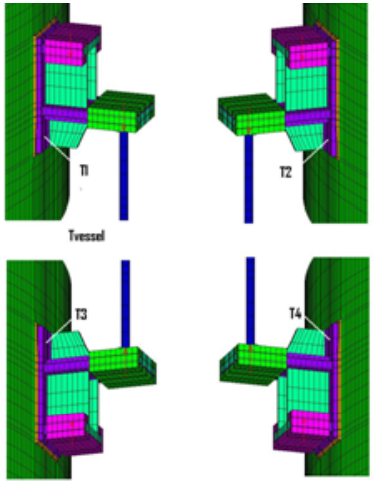
Figure 2 - Support Leg-to-Vessel Weld Dimensions

Original weld configuration – standard chair
Note: received from M. Smith (E-mail)

Red elements represent the actual welds

Welding scenario for the redesigned VV-Chair support



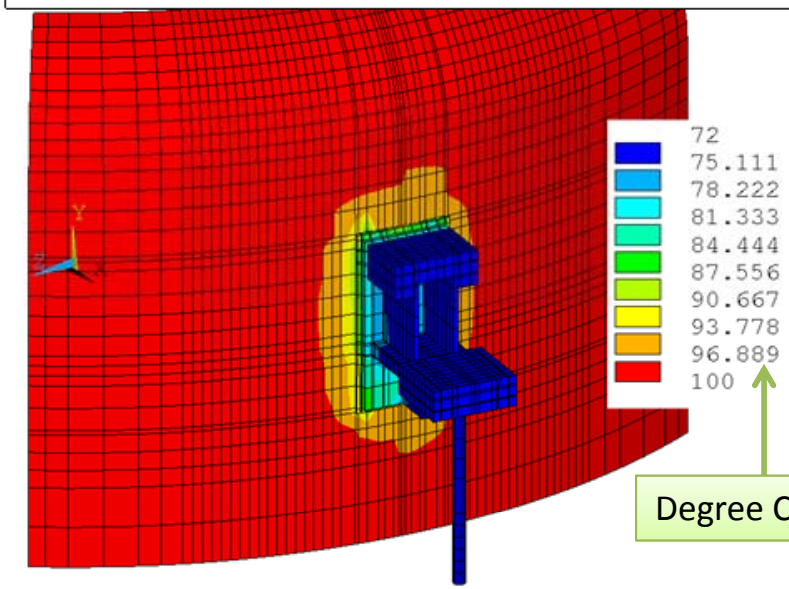


RUN #6
Bakeout

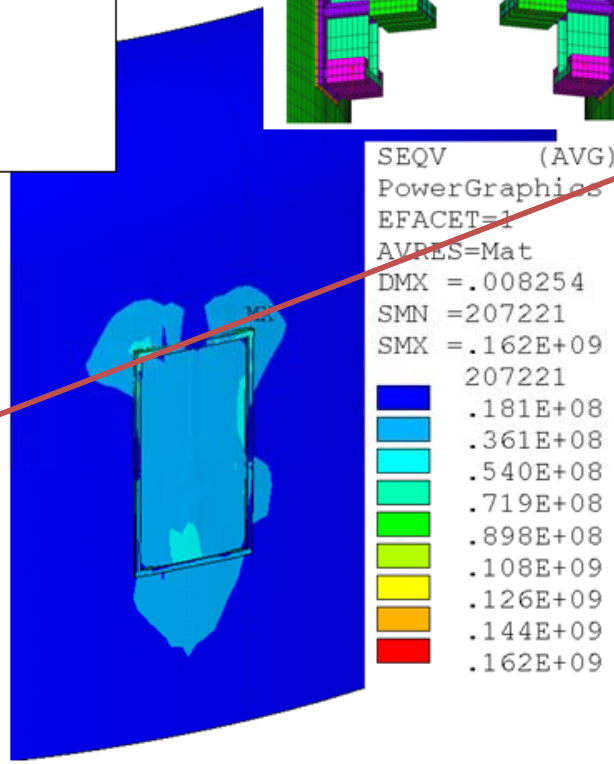
Conversion to degrees F

C	F
75.1	167.20
78.2	172.76
81.3	178.34
84.4	183.92
87.6	189.68
90.7	195.26
93.8	200.84
96.9	206.42
100.	212.0

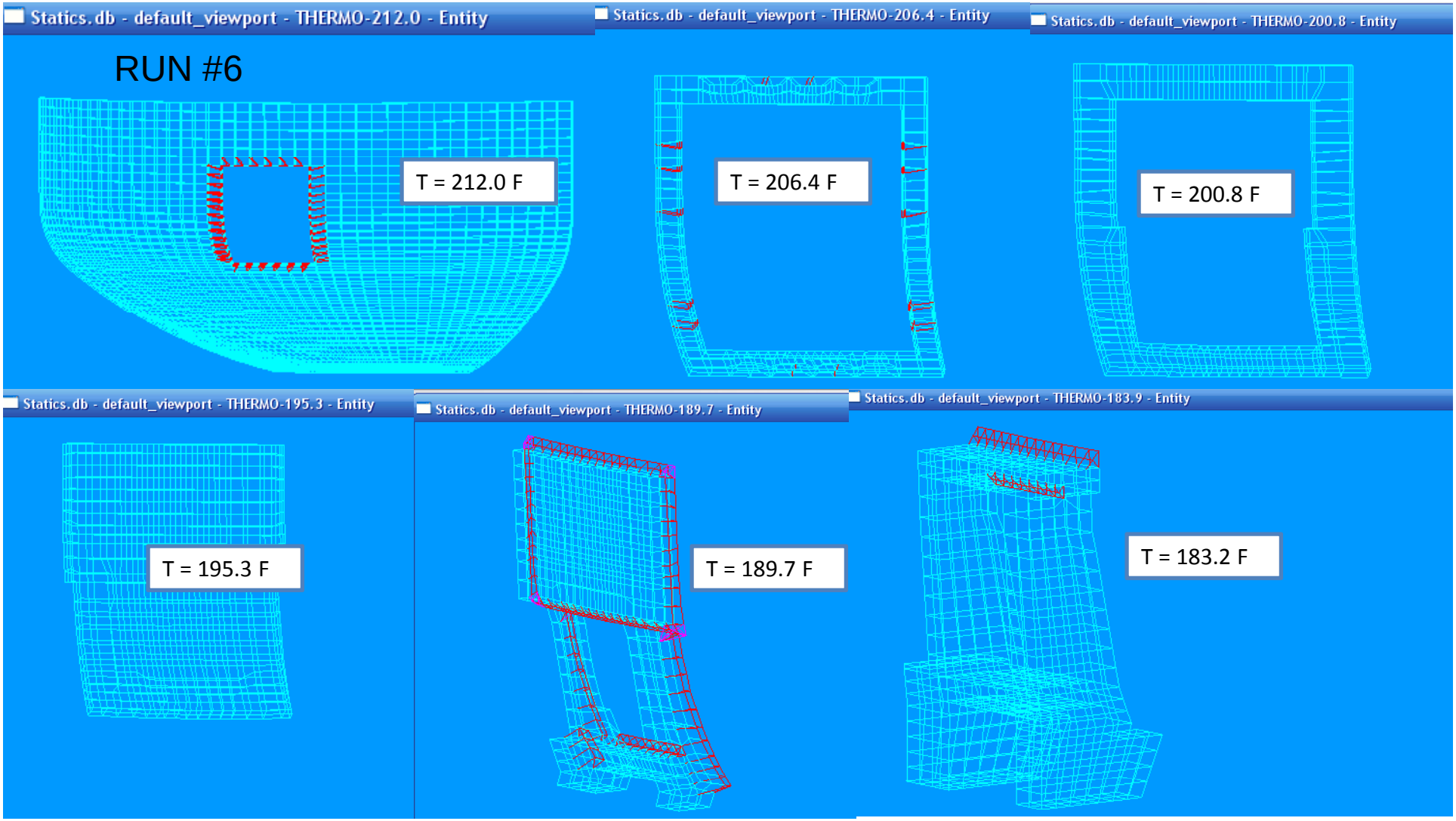
Use this for RUN #6



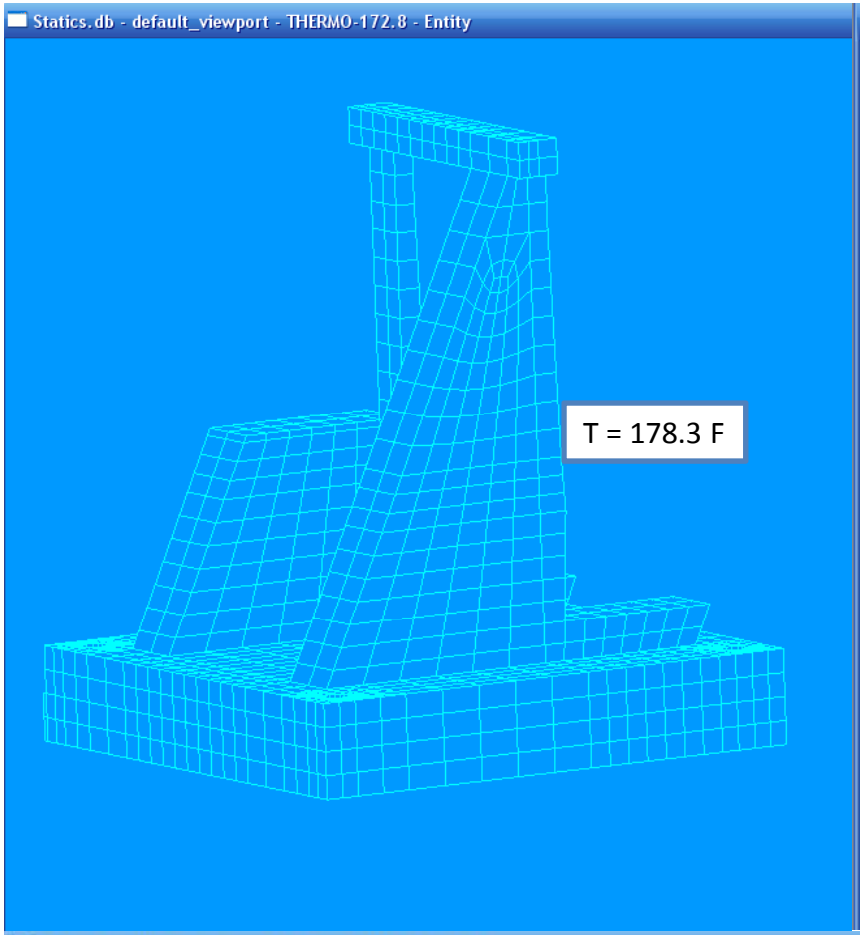
Degree C

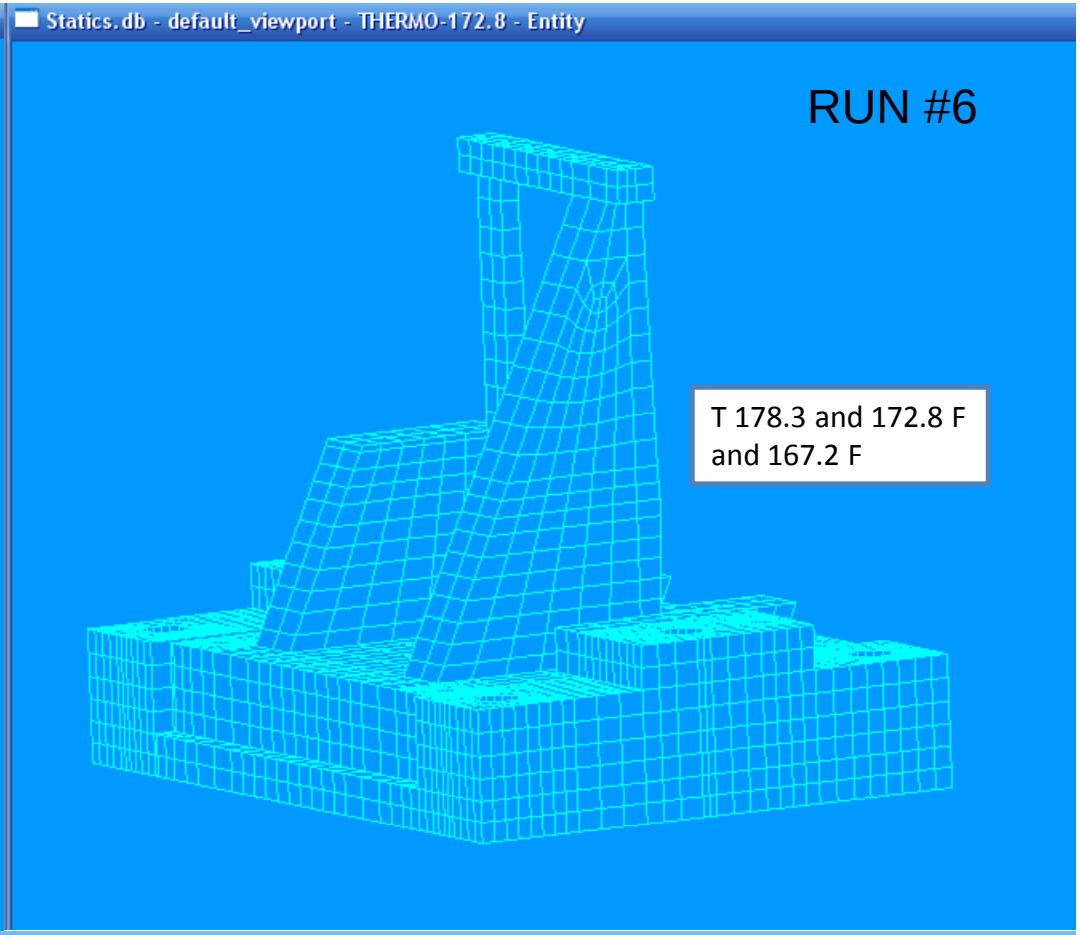


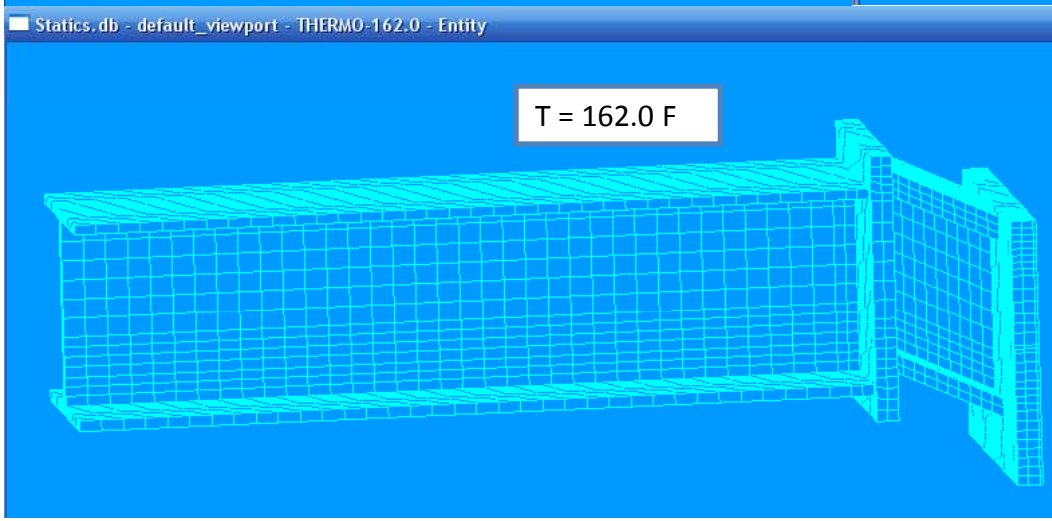
This data is taken from the previous PF 4 and 5 support hardware simulation. Similar temperature scenario exists in the area of contact between the VV and the main support Chair structure.
This temperature data has to be converted to degrees F in order to be used in the present RUN #6 simulation.



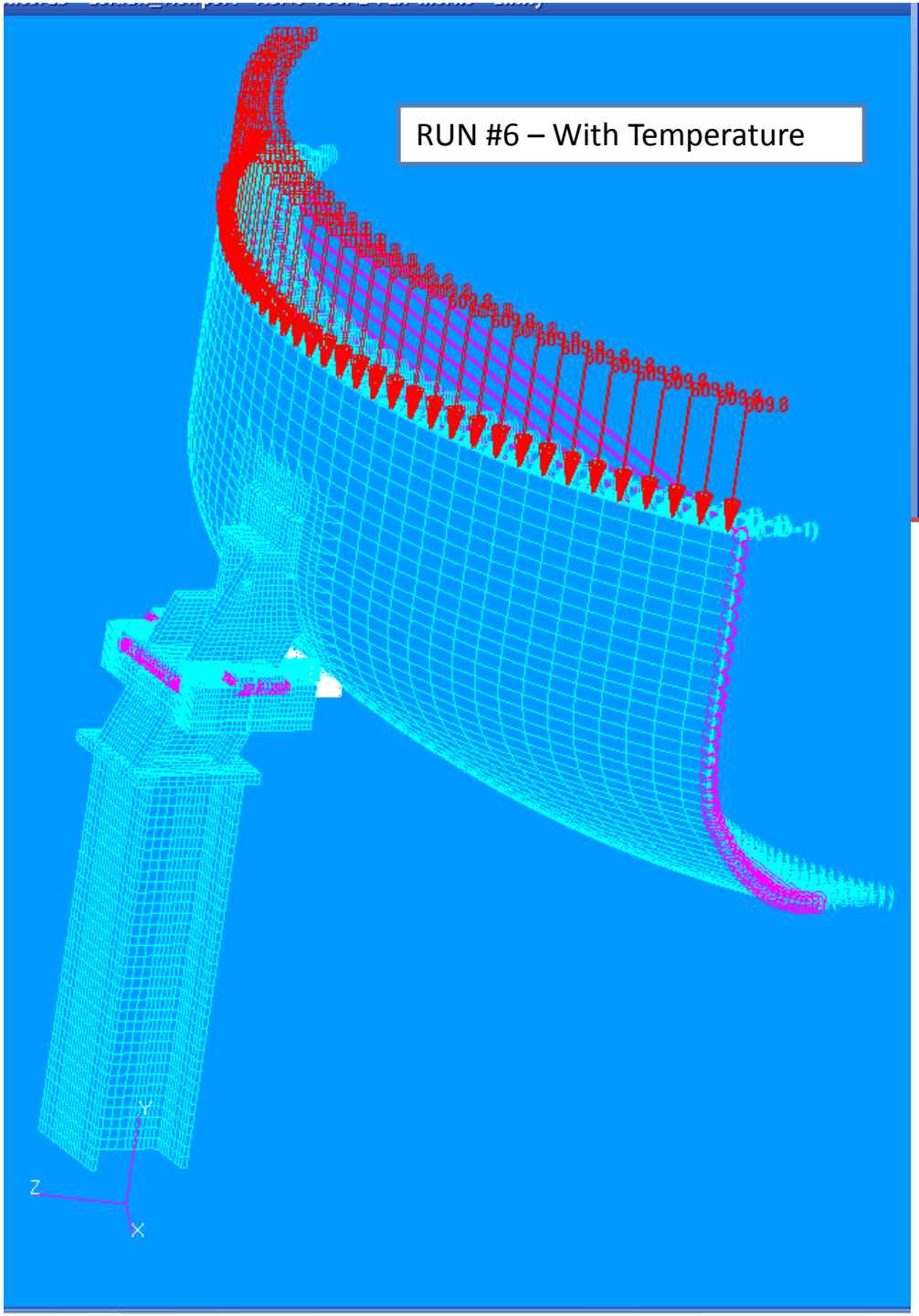
Applied temperature distribution according to the converted table from the previous slide. These groups are most critical in order to determine the VV bake out effects. This is a highly approximated temperature profile. The VV support structure is a very effective heat sink. Because of its total mass, the gradients are probably reasonable. If better simulation is necessary, then, a complete thermal analysis would be required to determine temperature at each nodal point (time consuming procedure).







Please Note: The described temperature distribution is the result of the author's assumed interpolation.

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$ Nonlinear Static Analysis, Database
SOL 106
CEND
TITLE = MSC.NASTRAN JOB CREATED ON 17-FEB-12 AT 08:48:38
ECHO = NONE
MPC = 20134
TEMPERATURE(INITIAL) = 10
SUBCASE 1
   TITLE=106 with THERMO
   SUBTITLE=RUN6-Loads
   NLPARM = 1
   SPC = 2
   LOAD = 12
   TEMPERATURE(LOAD) = 2
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   SPCFORCES(SORT1,REAL)=ALL
   STRAIN(SORT1,REAL,VONMISES,STRCUR,BILIN)=ALL
   STRESS(SORT1,REAL,VONMISES,BILIN)=ALL
$ Direct Text Input for this Subcase
BEGIN BULK
$ Direct Text Input for Bulk Data
PARAM     POST     0
PARAM     AUTOSPC YES
PARAM    PRTMAXIM YES
NLPARM    1        10              AUTO     5        25              NO
$ Elements and Element Properties for region : HexWedTet
```

From the "RUN6.bdf" file

Group – RUN6-106HL-FEA-thermo
Input -- RUN6-NL-THLoads.bdf
Loads -- RUN6-Loads
Output – RUN6-NL-THLoads.xdb

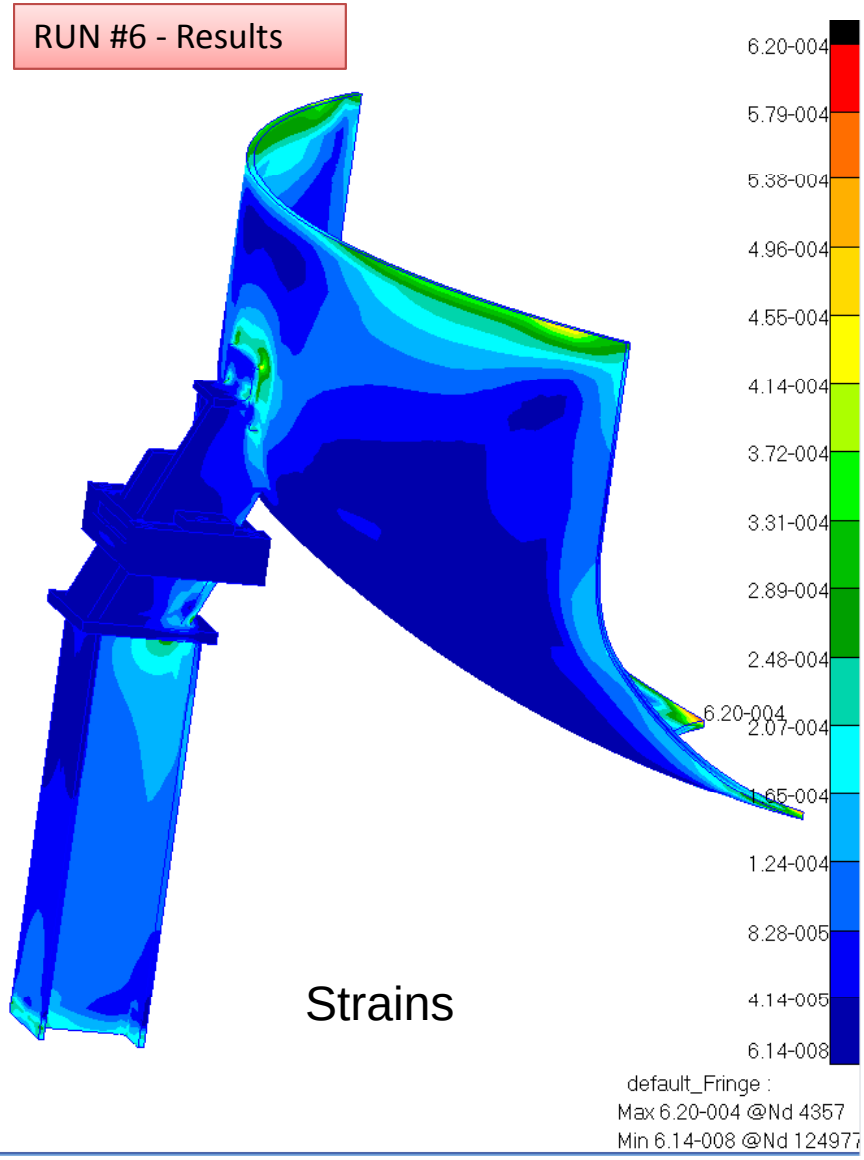
RUN #6 Loads formulation is as follows:

Mechanical loads and B.C. are identical to those applied in RUN #4, plus the described temperature distribution scenarios on the previous slides.

MSC FEA 2010.1.2 64-Bit 16-Mar-12 14:47:52

Fringe: RUN6-Loads, A7:Non-linear: 100. % of Load, Strain Tensor, , .

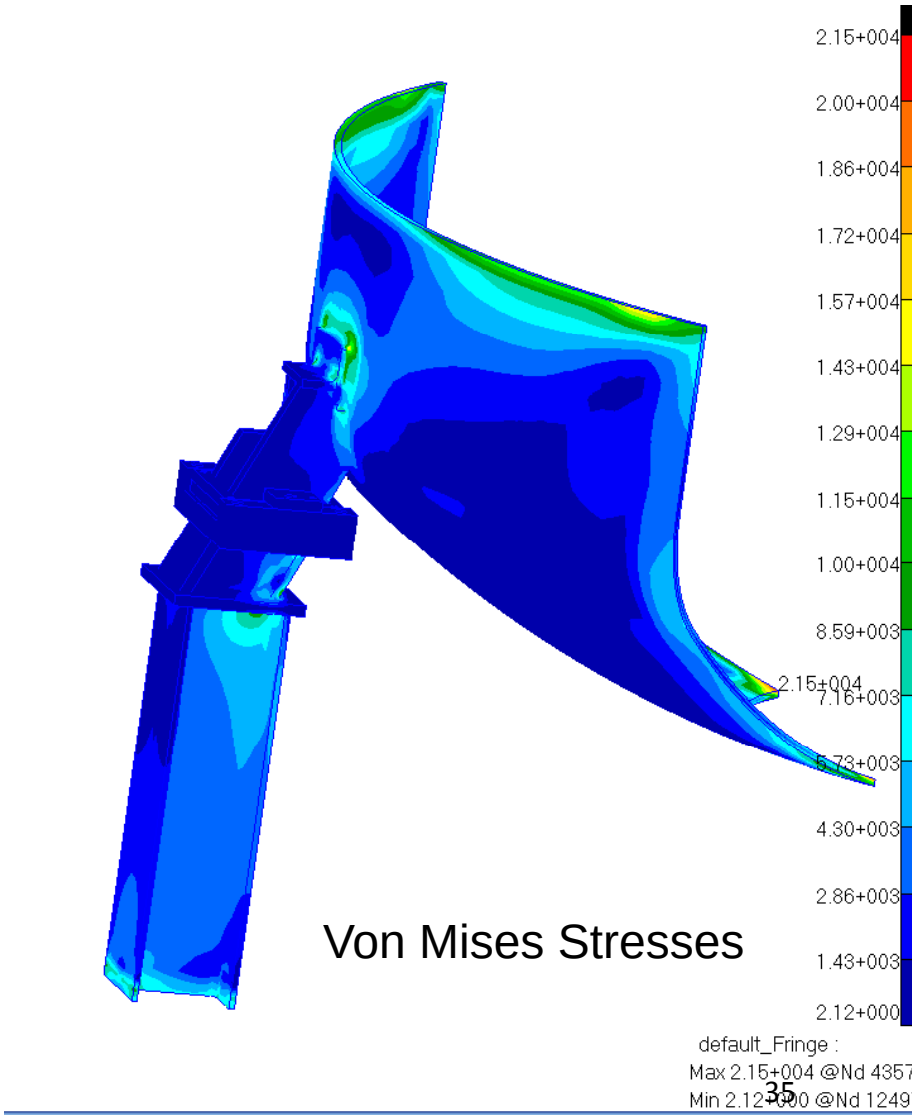
RUN #6 - Results



Strains

MSC FEA 2010.1.2 64-Bit 16-Mar-12 14:44:43

Fringe: RUN6-Loads, A7:Non-linear: 100. % of Load, Stress Tensor, , von Mises, (NON-LAYERED)



Von Mises Stresses

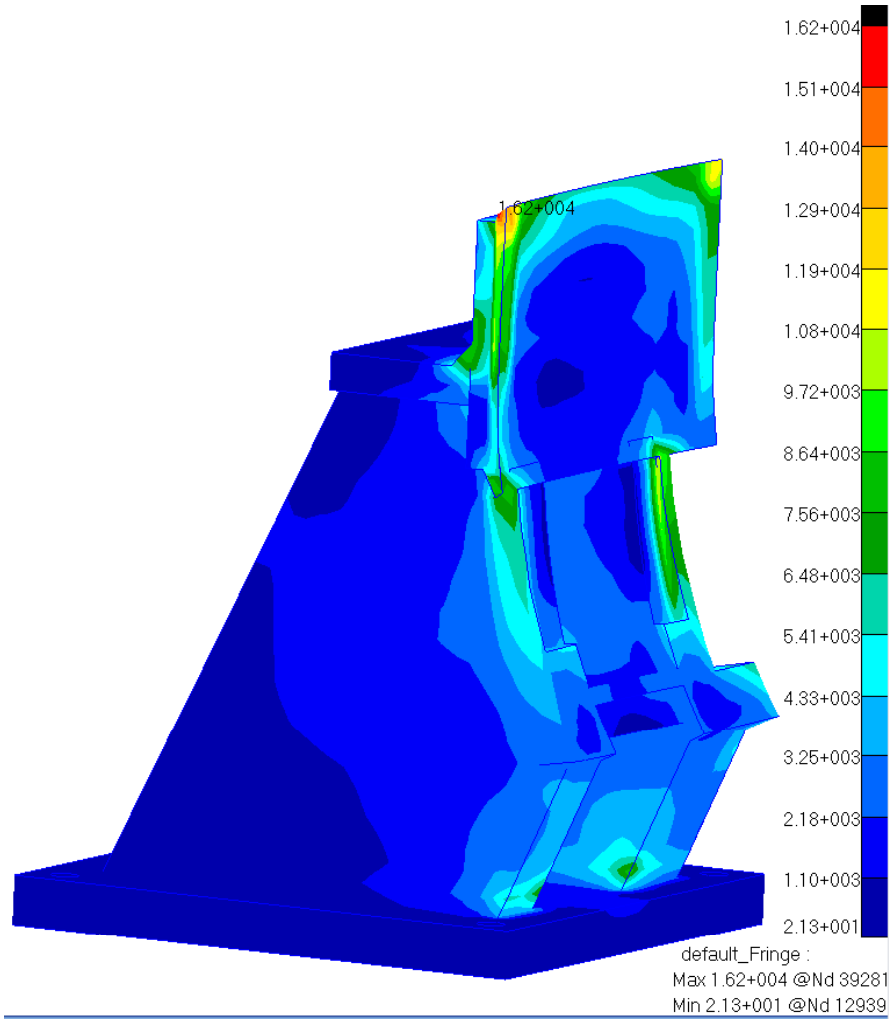
MSC FEA 2010.1.2 64-Bit 16-Mar-12 15:09:15

Fringe: RUN6-Loads, A7:Non-linear: 100. % of Load, Stress Tensor, , von Mises

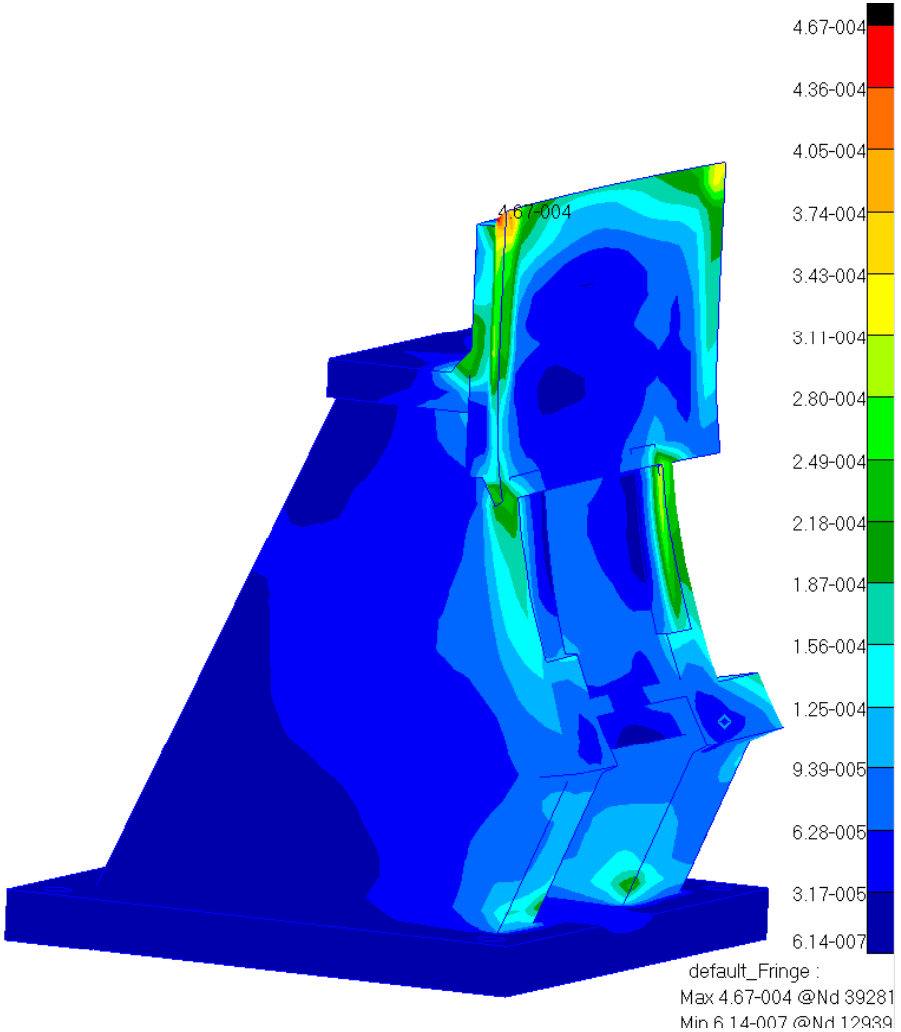
MSC FEA 2010.1.2 64-Bit 16-Mar-12 15:05:31

Fringe: RUN6-Loads, A7:Non-linear: 100. % of Load, Strain Tensor,

RUN #6 - Results



Von Mises Stresses

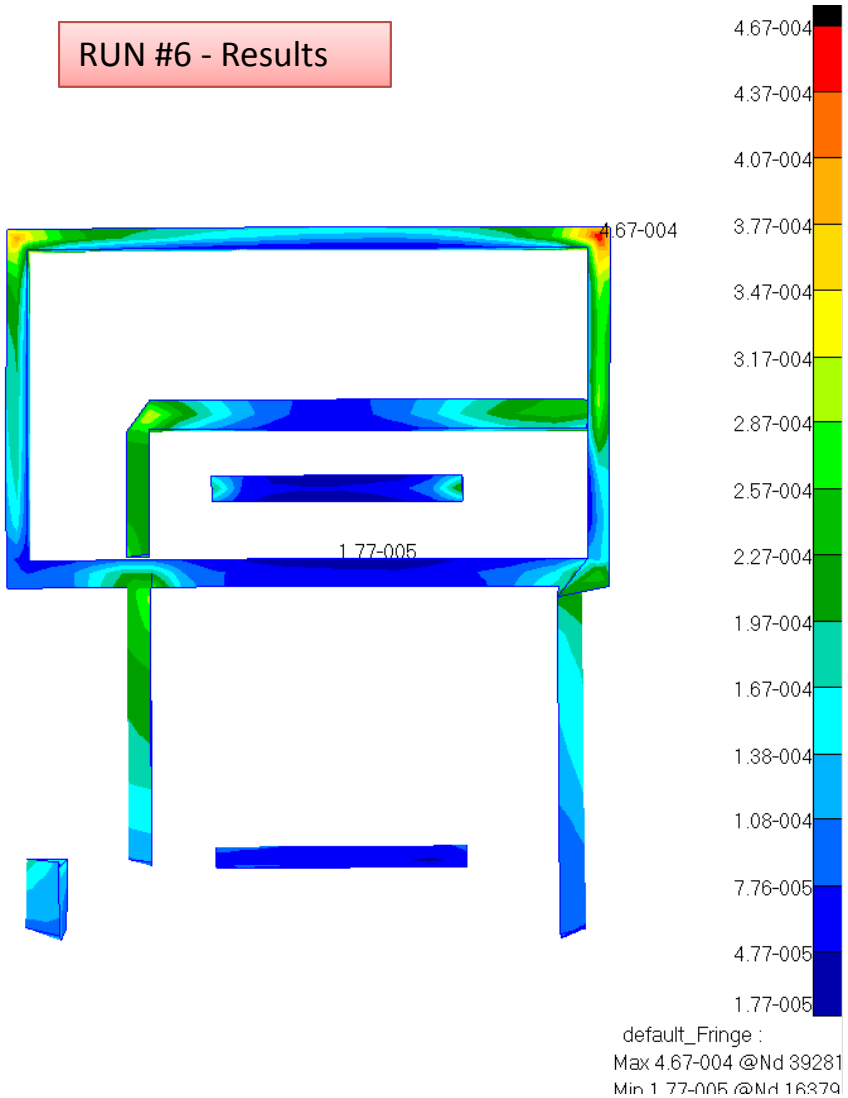


Strains

MSC FEA 2010.1.2 64-Bit 16-Mar-12 15:22:36

Fringe: RUN6-Loads, A7:Non-linear: 100. % of Load, Strain Tensor, , .

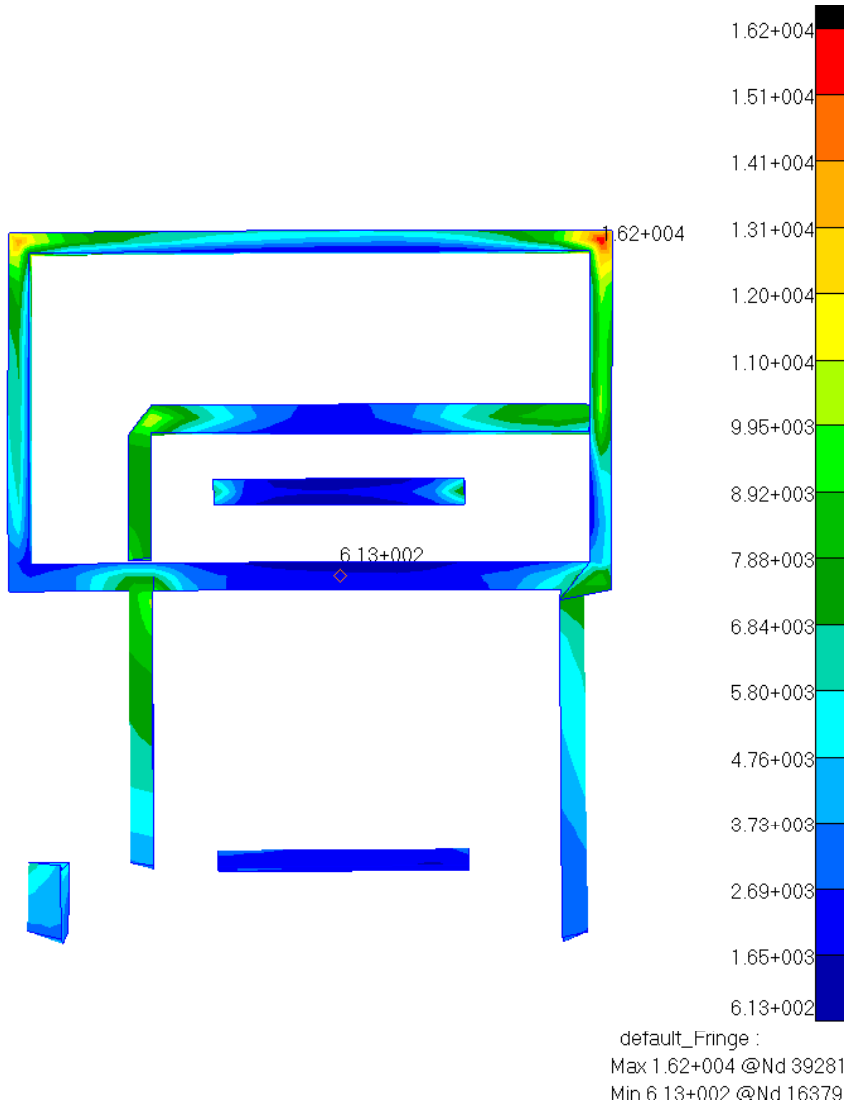
RUN #6 - Results



Strains

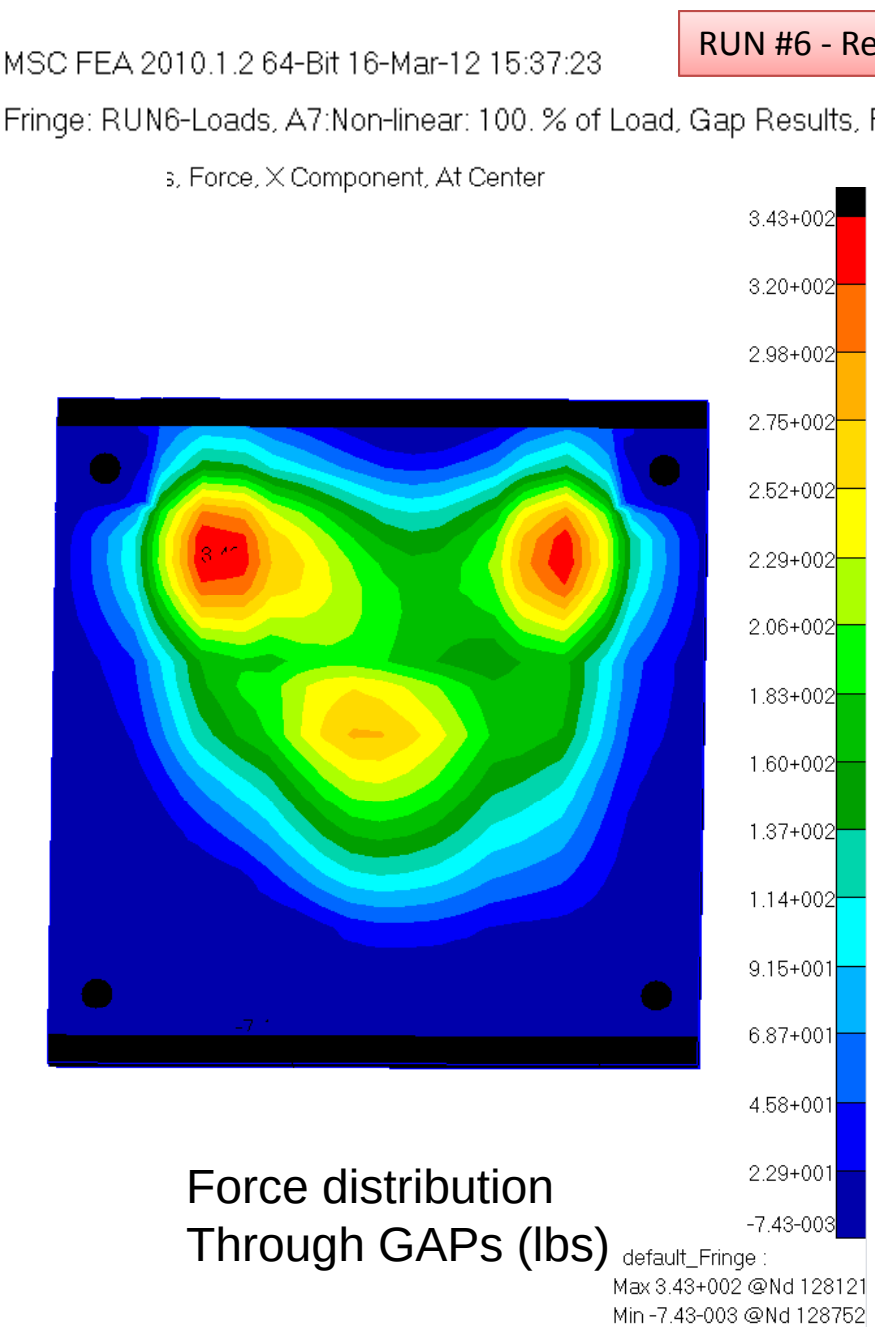
MSC FEA 2010.1.2 64-Bit 16-Mar-12 15:17:01

Fringe: RUN6-Loads, A7:Non-linear: 100. % of Load, Stress Tensor, , von Mises

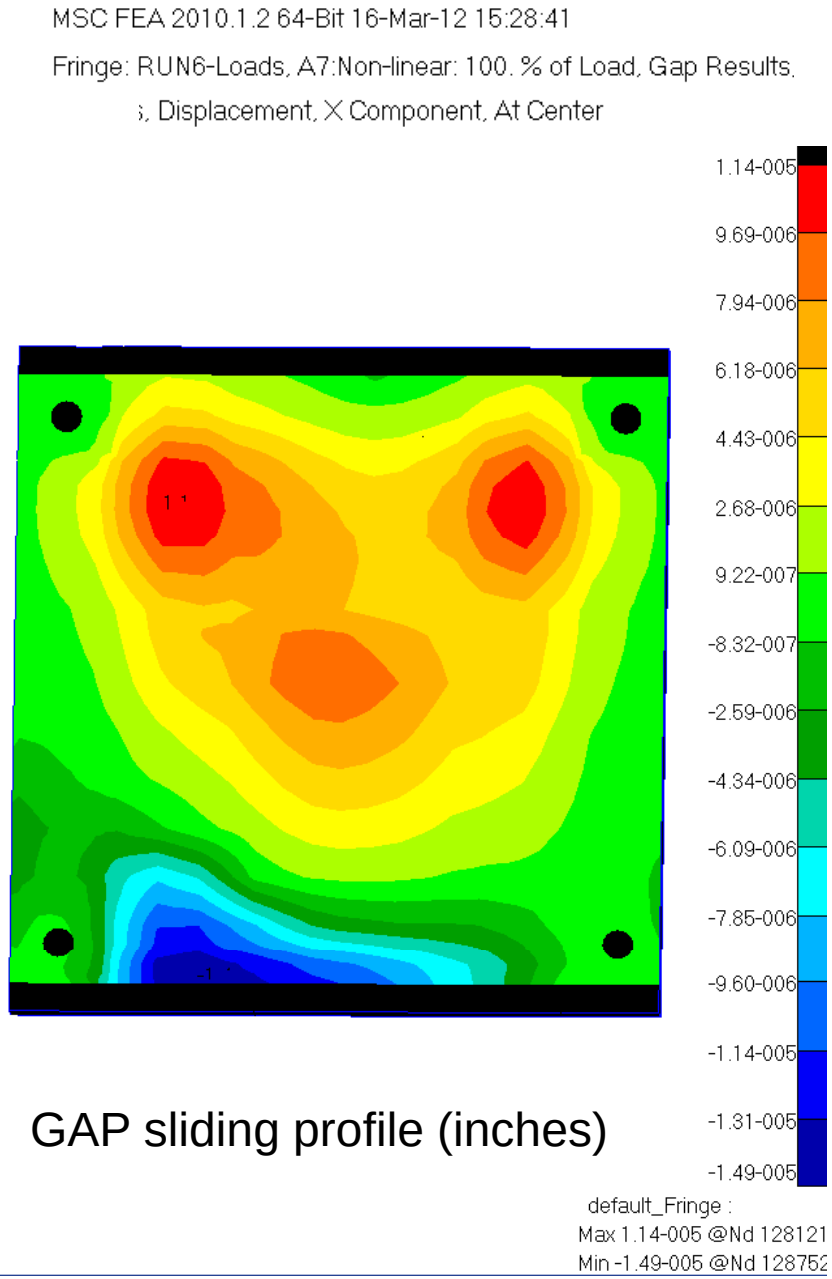


Von Mises Stresses

RUN #6 - Results



Force distribution
Through GAPs (lbs)



GAP sliding profile (inches)

Complete Summary explanation for all Runs

From the examinations of the six different FEA simulations presented by the above slides, the following evaluation can be stated:

- Basic FEA geometry simulations (nodal points, elements), for all runs, are the identical.
- The differences are in the applications of the model support/boundary conditions (SPCs) and their locations for each specific run. This was implemented in order to fully investigate the worst possible magnitude and locations of stresses and strains in the critical areas (especially the welded locations between the VV and the support structure).
- Runs #1, #2 and #3 are fully linear (the sliding effects were not considered). GAPs were replaced with RBE2 rigid elements. Runs #4, #5, #6 are non linear (NASTRAN Solution 106) where GAPs were fully utilized to evaluate the contributions due to the VV-Chair sliding effects. For these runs, GAP element contours are included to evaluate the correctness of the load transmission at the sliding surface (see the appropriate slides).
- Runs #1 and #2 were included here only for model verification and to demonstrate the effects of some extreme boundary support conditions which are used to improve the total model simulations.

In general, the following can be concluded and recommended for minimizing stresses and strains: For Run #1 under the most severe boundary conditions, the maximum stresses in the weld locations are equal to 15,300. psi. For Run #2 (less severe boundary condition) maximum weld stress decrease to 10,200. psi. From these two runs, the maximum possible stresses are established for total VV dead weight effects. Inclusion of the additional static loads may change the locations as well as the stress/strain values.

Complete Summary explanation for all Runs (cont.)

Run #	Welds Maximum VM Stress	Welds Maximum Strain	Chair Body Maximum VM Stress	Chair Body Maximum Strain
#1	15,300. psi	.0004	56,700.*	.0002
#2	10,200.	.0005	12,500.	.0005
#3	10,500.	.0003	15,500.	.000444
#4	11,100.	.00032	15,200.	.000438
#5	15,700.	.00045	21,100.	.00061
#6	16,200.	.00047	21,500.	.00062

* This stress is high because of the conservative boundary conditions used and should be disregarded. (see RUN #1 results slides)

Final conclusion - Recommendations

Stainless steel with a yield stress of 42,000 psi was used for these analyses. Comparing to the above table, all the stress and strains are well within allowable limits (with the exception of Run #1 as noted above) and provides an adequate static margin for welds and the support structure alike.

Strong recommendation is to weld corner locations carefully in order to minimize the stress concentrations there (see Slide 30). It is advised that regular inspections of these locations should be performed.

Appendix A

All the data is saved in the following locations and it includes: the write up, analyses data base which includes all the analyses groups, input files for all completed runs (.bdf files), and the output results (.xdb files).

Folder name is “Vessel-Support-Chair-Data”

P:\public\Snap-srv\progoff

G:\Nastran P.R. - (external drive on ASALEHZ-64PC)