Estimation of Wake Field, Heating in Modified Beam Pipe
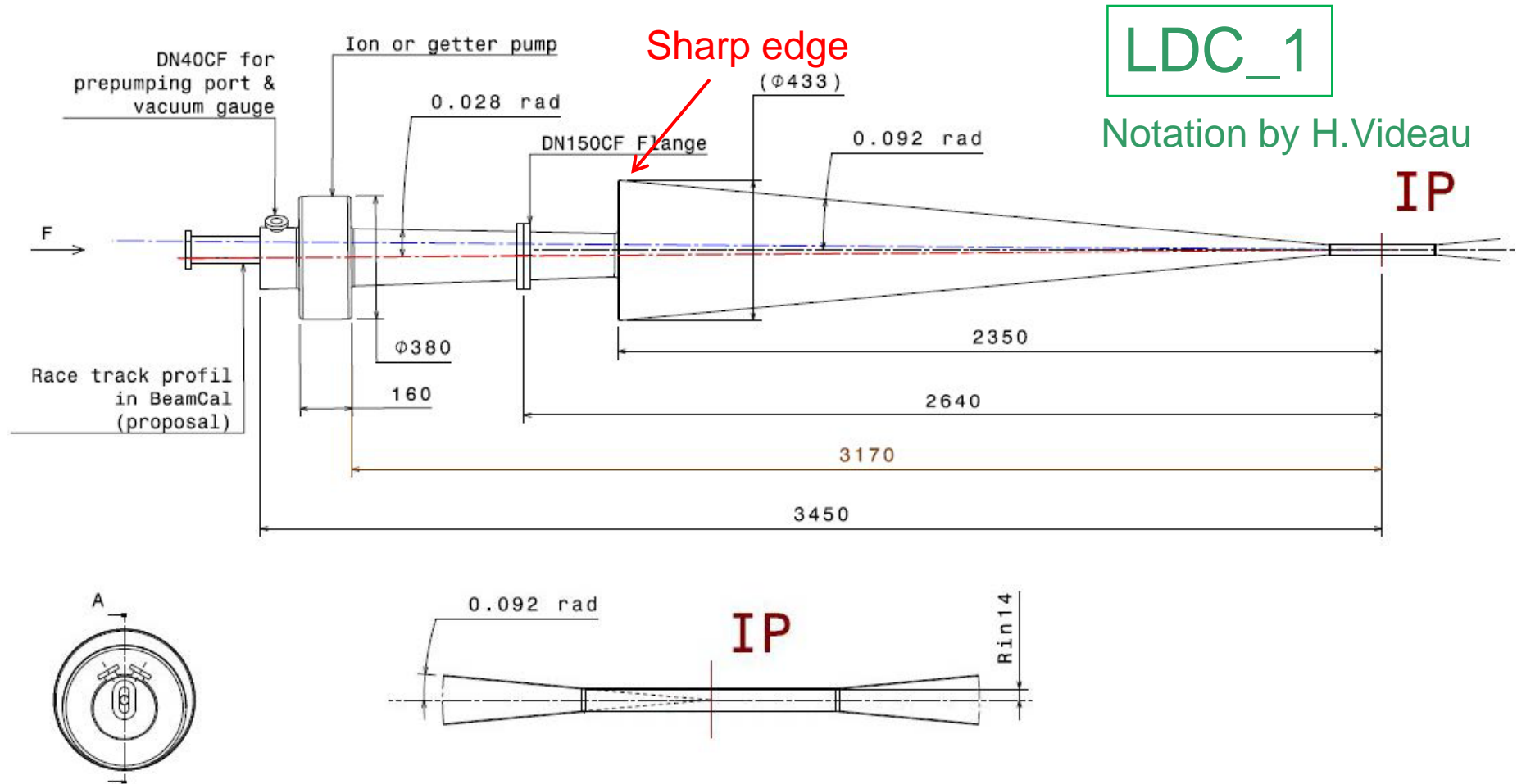
Y. Suetsugu, KEK

- Loss factor
- Structural strength

- ## Base Model

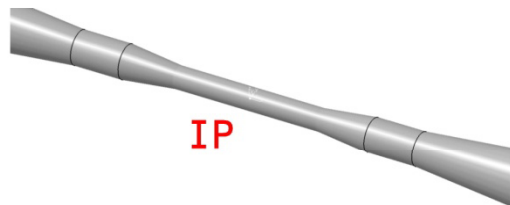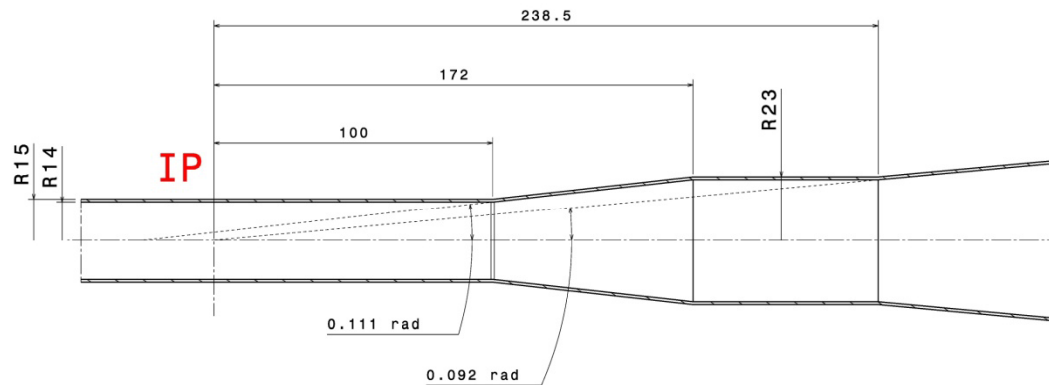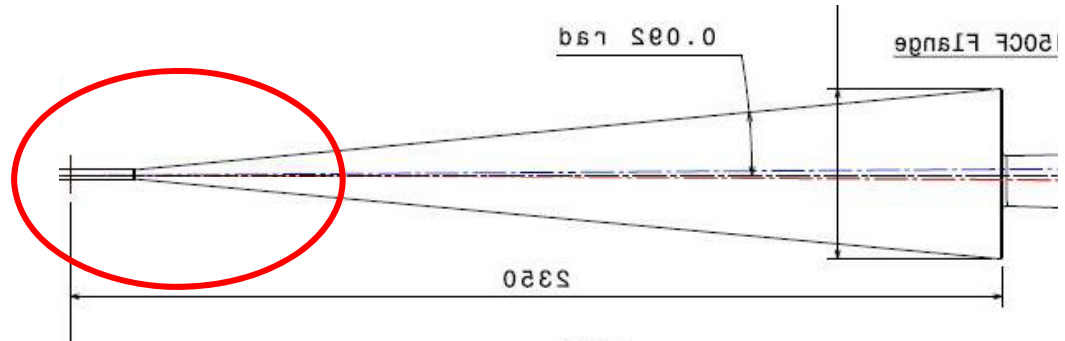Sharp edge

LDC_1

Notation by H.Videau

Loss factor

- **Modified Model**

With step

Calculations similar to those of TILC08 were performed.

- Model for calculation

Beam

Out ⟵

In ⟶

Total length = 3.8 m
$\Delta z = 0.1$ mm
$\Delta r = 0.5$ mm
Axisymmetrical (2D)

IP

Calculate for $\sigma_z = 2 - 9$ mm

Extrapolate to $\sigma_z = 0.3$ mm
(Due to limited memory and time)
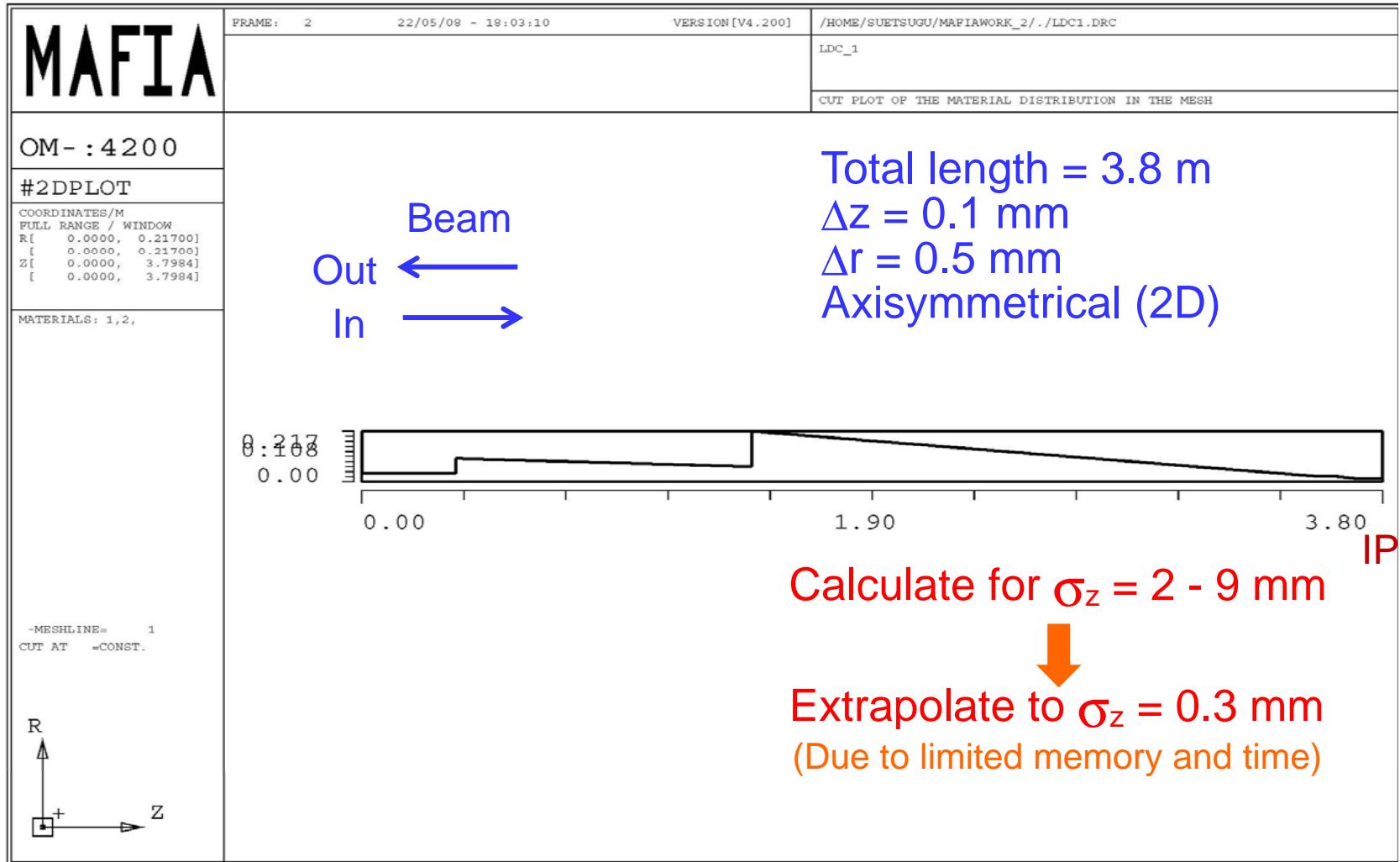
Loss factor

- ## Results

k_{in} and k_{out} is different, since the apertures at both ends are different.

k_{total} (two beams) $\sim 7 \times 10^{13}$ V/C
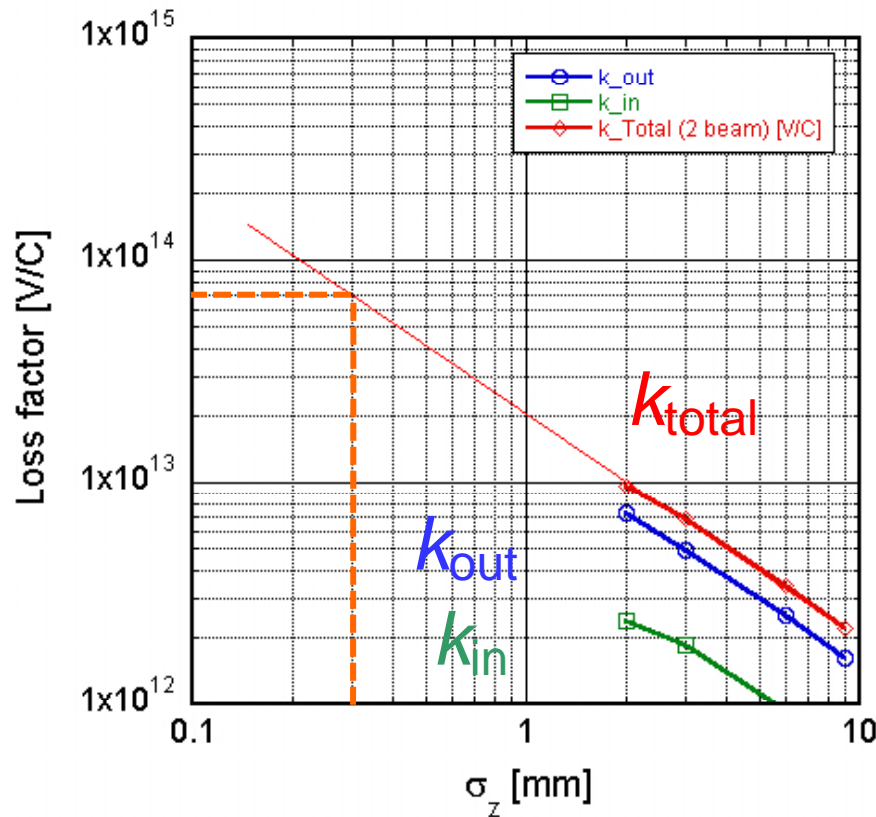@ $\sigma_z = 0.3$ mm

If $q = 3.2$ nC, $N_b = 5400$ bunch, and $f_r - 5$Hz : $I - 8.6 \times 10^{-5}$ A

$\therefore P = kqI = \sim 20$ W (one side)

Almost the same to the result for LDC-1

- Comparison
  - σ_z = 3 mm
  - **Two beams**

Type	Loss factor (k_{total})	Ratio
LDC-1	6.81731×10^{12}	100%
LDC-1_mod	6.79690×10^{12}	99.7%
LDC-2	6.71416×10^{12}	98.5%
LDC-3	6.68828×10^{12}	98.1%

No effect on the loss factor

- ## Deformation and stress

  - **Material: Al alloy (Al5052, H34)**
  - **Thickness A: 1 mm, B: 3 mm**
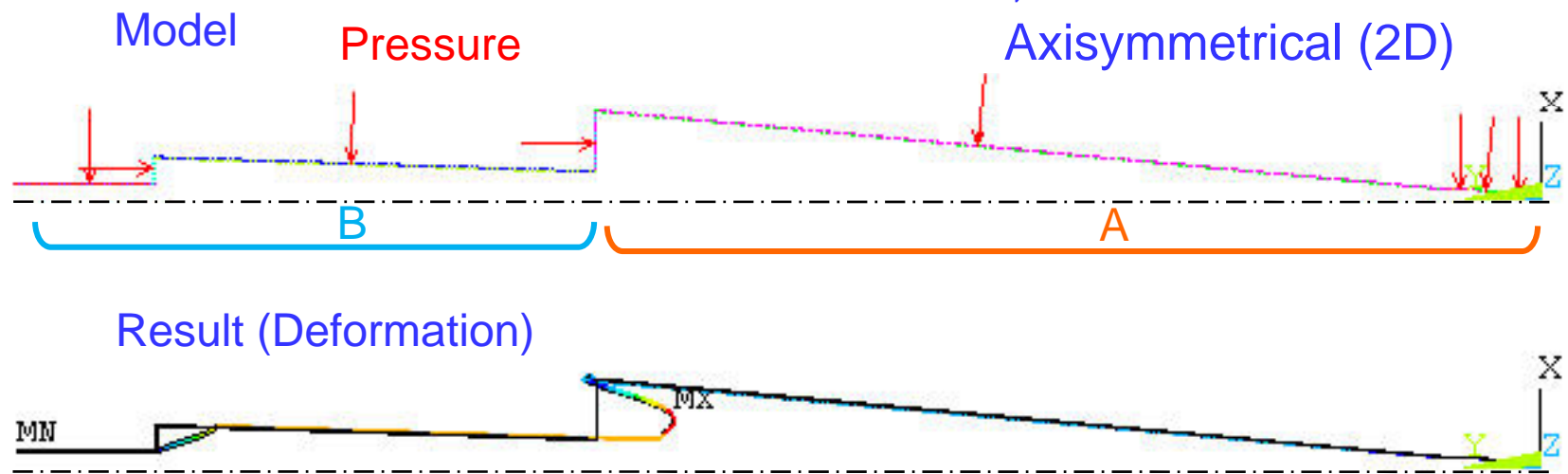 - **Load: Atmospheric pressure (1.013×10^5 Pa)**
  - **By ANSYS**

Total length = 3.8 m
$E = 7.056 \times 10^{10}$ N/m^2
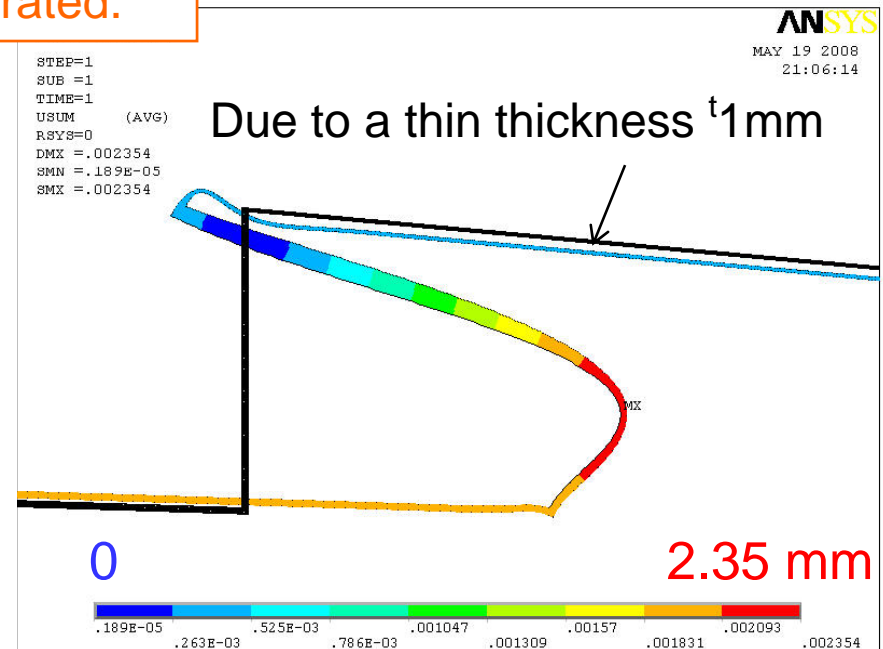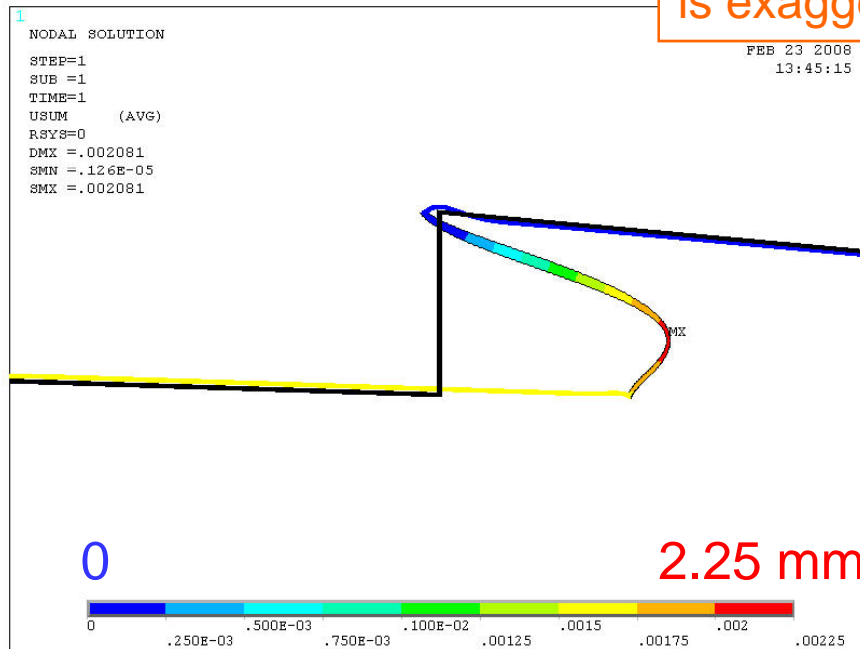$\nu = 0.3$
Axisymmetrical (2D)

Model   Pressure

B   A

Result (Deformation)

Structural strength

- Result: Deformation

LDC_1   Deformed shape is exaggerated.   Modified

NODAL SOLUTION
STEP=1
SUB =1
TIME=1
USUM   (AVG)
RSYS=0
DMX =.002081
SMN =.126E-05
SMX =.002081

FEB 23 2008
13:45:15

0   2.25 mm

0   .250E-03   .500E-03   .750E-03   .100E-02   .00125   .0015   .00175   .002   .00225

STEP=1
SUB =1
TIME=1
USUM   (AVG)
RSYS=0
DMX =.002354
SMN =.189E-05
SMX =.002354

MAY 19 2008
21:06:14

Due to a thin thickness ^{t}1mm

0   2.35 mm

.189E-05   .525E-03   .001047   .00157   .002093
    .263E-03   .786E-03   .001309   .001831   .002354
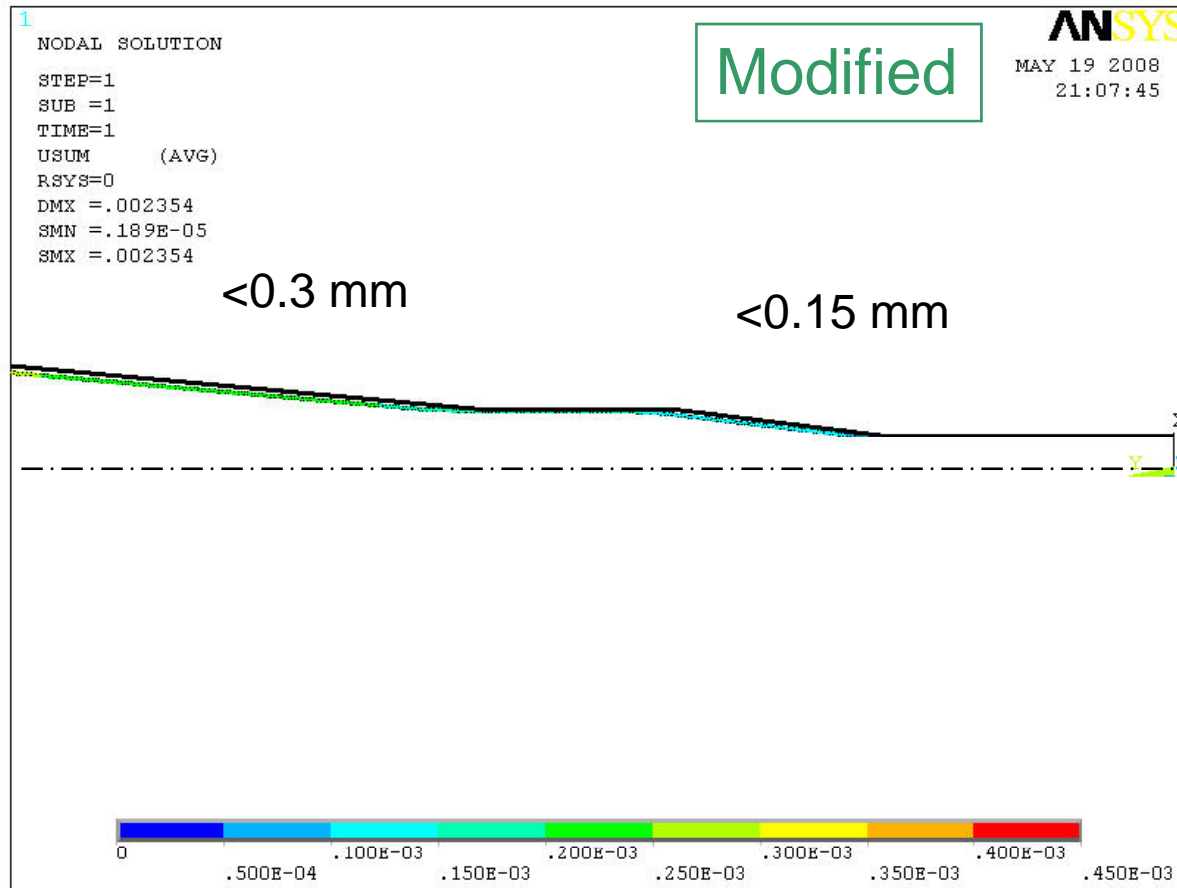
Deformation is a little bit large, but almost the same.

- Result: Deformation (near IP)

Deformed shape is exaggerated.

```
1
NODAL SOLUTION

STEP=1
SUB =1
TIME=1
USUM      (AVG)
RSYS=0
DMX =.002354
SMN =.189E-05
SMX =.002354
```
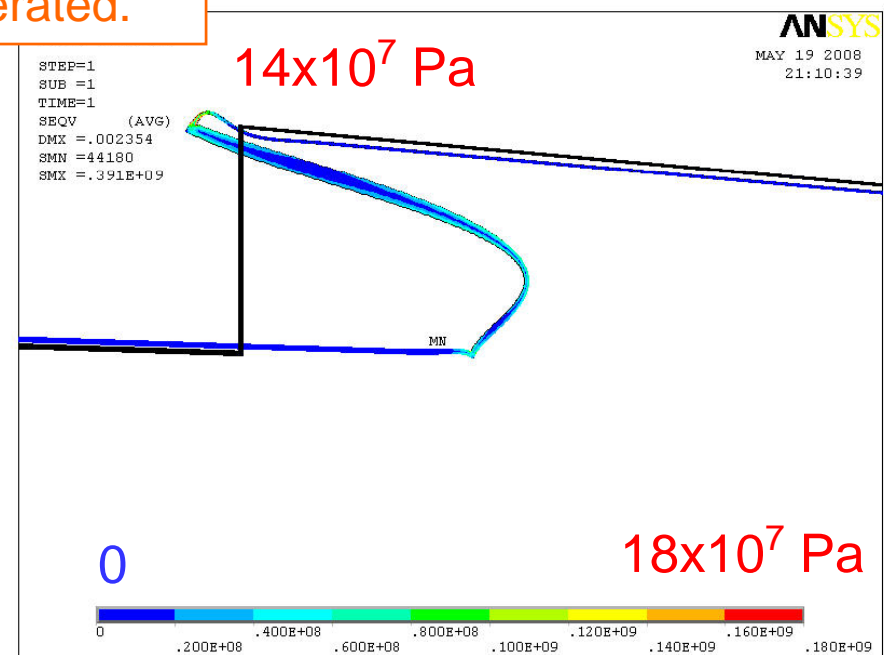
Modified

ANSYS

MAY 19 2008
21:07:45

<0.3 mm

<0.15 mm

```
0                .100E-03            .200E-03            .300E-03            .400E-03
      .500E-04            .150E-03            .250E-03            .350E-03            .450E-03
```

Structural strength

- Result: Stress (Von Mises stress)

LDC_1

Modified

Deformed shape is exaggerated.

14×10^7 Pa

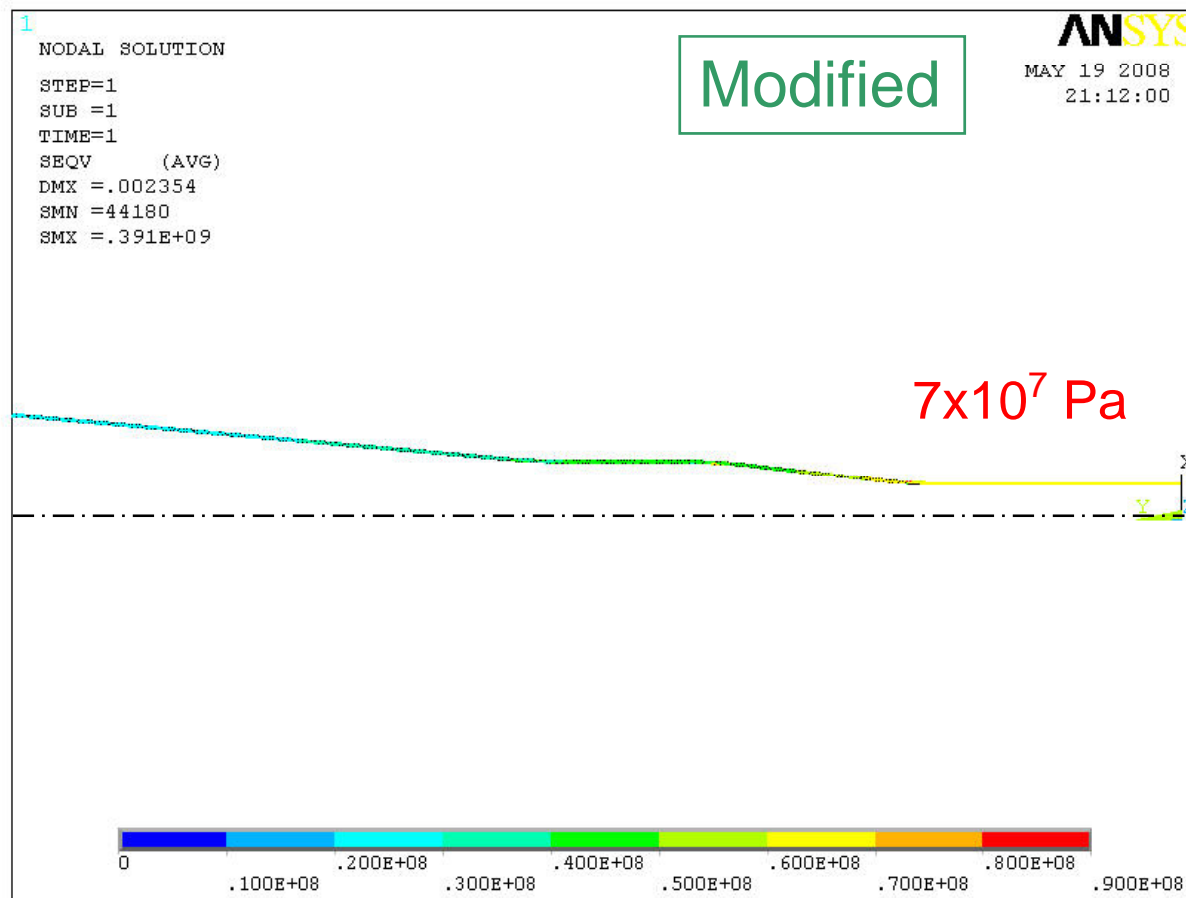0 9×10^7 Pa

0   18×10^7 Pa

(Yield strength of aluminum alloy is 22×10^7 Pa)
Be careful about the welding at the edge. 1mm?

Structural strength

- Result: Stress (Von Mises stress)(near IP)

Modified

Deformed shape is exaggerated.

May be no problem

7×10^7 Pa

Calculation for actual Be is required.

- The modification has little effect on:
  - **Loss factor**
  - **Structural strength**
  - **Pressure profile**
- For further consideration:
  - **Calculation using real material properties is required.**
  - **Insertion of bellows? (possible? how?)**
  - **How to fix (support) chambers?**